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INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

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AMERICAN MUSEUM NOVITATES

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New York City

MORE PHALANGIDA FROM MEXICO

BY CLARENCE J. AND MARIE L. GOODNIGHT[1]

The present paper is a continuation of the studies by the authors on the phalangid fauna of Mexico (see Amer. Mus. Novitates, nos. 1163 and 1211, 1942). As has already been demonstrated, the phalangid fauna of Mexico is extremely rich in species and is relatively unknown taxonomically. A notable addition to the Mexican fauna is the fine cave phalangodid, *Chinquipellobunus osorioi*, new genus and species, which was found in three caves in Nuevo Leon.

The writers are indebted to Drs. C. Bolívar and F. Bonet of Mexico, D. F., for the opportunity to study much new material from widely separated parts of Mexico. They were ably assisted in the accumulation of these many new specimens by their colleagues, Drs. D. Peláez, B. Osorio, and M. Maldonado. In addition, the writers wish to acknowledge the receipt of a fine collection from Dr. Helmuth Wagner of Mexico, D. F.

All holotypes of new species are deposited in the collection of the American Museum of Natural History.

SUBORDER LANIATORES THORELL

PHALANGODIDAE Simon

Phalangodinae Roewer

CHINQUIPELLOBUNUS, NEW GENUS

Dorsum with five distinct areas, all dorsal areas and free tergites without median armature. Eye tubercle in the form of a rounded cone, slightly separated from the anterior median margin of the cephalothorax. Femur of the palpus without a median apical spine. Secondary sexual characteristics of the male in the enlarged chelicerae and in the spination of the femur of the fourth leg. Tarsal segments: 5-more than 6-6-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments. In one male specimen, there were 6 segments in the first tarsus.

GENOTYPE: *Chinquipellobunus osorioi*, new species.

Chinquipellobunus is related to *Metapellobunus* Roewer but differs in the number of tarsal segments.

Chinquipellobunus osorioi, new species

Figures 4–9

Total length of body, 6.4 mm. Cephalothorax, 1.0 mm. Width of body at widest portion, 3.7 mm.

	I	II
Trochanter	0.7 mm.	0.8 mm.
Femur	3.1	4.7
Patella	1.1	1.4
Tibia	2.6	4 4
Metatarsus	4.2	6 0
Tarsus	2.2	5.8
Total	13.9 mm.	23.1 mm.

	III	IV
Trochanter	0.9 mm.	0.9 mm.
Femur	4.1	5.4
Patella	1.2	1.6
Tibia	3.1	4 2
Metatarsus	5.1	6.3
Tarsus	2.3	2 9
Total	16.7 mm.	21.3 mm.

Dorsum with five areas, the boundaries of which are parallel. First area without a median line. All areas thickly covered with tuberculations. A row of tubercles on the lateral margin of the dorsum. Cephalothorax with tuberculations which are more

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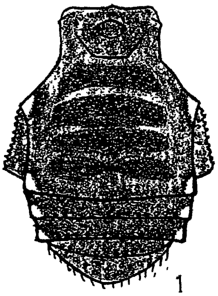
[1] University of Illinois, Urbana, Illinois.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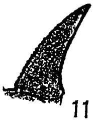
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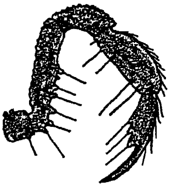
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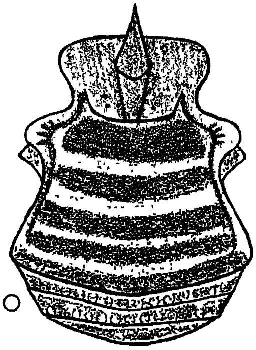
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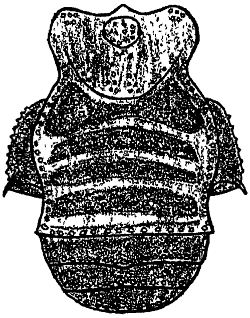
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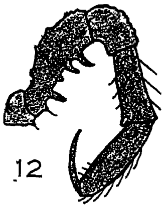
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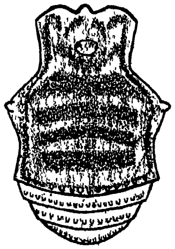
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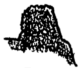
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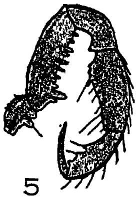
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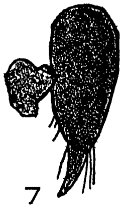
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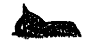
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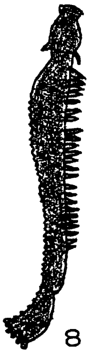
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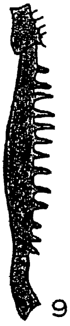
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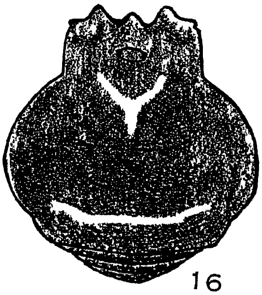
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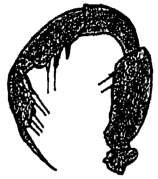
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Fig. 1. *Monterella tuberculata*, new species, dorsal view of male.
Fig. 2. Idem, retrolateral view of palpus of male.
Fig. 3. Idem, lateral view of eye tubercle of male.
Fig. 4. *Chinquipellobunus osorioi*, new species, dorsal view of male.
Fig. 5. Idem, retrolateral view of palpus of male.
Fig. 6. Idem, lateral view of eye tubercle of male.
Fig. 7. Idem, retrolateral view of chelicera of male.
Fig. 8. Idem, dorsal view of trochanter, femur, and patella of fourth leg of male holotype.
Fig. 9. Idem, dorsal view of trochanter, femur, and patella of fourth leg of male paratype.
Fig. 10. *Paramitraceras granulatus* Cambridge, dorsal view of male.
Fig. 11. Idem, lateral view of eye tubercle of male.
Fig. 12. Idem, retrolateral view of palpus of male.
Fig. 13. *Karos barbarikos*, new species, dorsal view of female.
Fig. 14. Idem, lateral view of eye tubercle of female.
Fig. 15. Idem, retrolateral view of palpus of female.
Fig. 16. *Boneta bilineata*, new species, dorsal view of male.

numerous just posterior to the eye tubercle and at the lateral margins. Eye tubercle in the form of a rounded cone, thickly covered with tuberculations; eyes at base with an apparently defective retina. Eye tubercle separated from the anterior margin of the cephalothorax by only a narrow space. Venter and coxae granulate, a transverse row of tubercles across each free sternite. Anal operculum with scattered tubercles. Third coxa with both anterior and posterior rows of lateral teeth. First coxa with a transverse row of large tubercles. All coxae and trochanters thickly covered with tubercles. Spiracles visible. Fourth coxa widened distinctly, visible from above, with a dorsal apical spine.

Legs: clothed throughout with hairs. Femora, patellae, and tibiae with granulations. Femur of the third leg somewhat enlarged and curved, with several rows of larger tubercles. Femur of fourth leg enlarged, with the large row of spines on the retrolateral margin. There is some variation among individuals in the number of spines present. Trochanter and tibia of fourth leg with two large distal spines. Metatarsi of legs not divided into astragulus and calcaneus. Tarsal segments: 5-12-6-6. One male specimen, among the many examined, had 6 segments in the first tarsus. Distitarsus of first tarsus with 2 segments; of second, 3 segments.

Palpus: trochanter, 0.9 mm. long; femur, 1.9; patella, 1.3; tibia, 1.3; and tarsus, 1.1. Total length, 6.5 mm. Palpus armed retrolaterally as in figure 5. There is a slight variation in the number of small spines on the tibia. Prolaterally: femur and patella unarmed, tibia and tarsus with 3 spines each. Entire dorsal portion of femur granulate.

Chelicera: enlarged, as in figure 7. Proximal segment covered with granulations. There is an occasional specimen with a somewhat smaller chelicera.

Entire body and all appendages except the metatarsi and tarsi of the legs reddish brown. Metatarsi and tarsi yellowish.

Female: Total length of body, 5.3 mm. Cephalothorax, 1.4 mm. Width of body at widest portion, 3.2 mm. Similar in appearance to male, but with the chelicera reduced in size and with less spination on the femur of the fourth leg.

Type Locality: Male holotype and male and female paratypes from Gruta del Carrizal, Nuevo Leon, July 16, 1942 (C. Bolívar, B. Osorio, D. Peláez, and F. Bonet). Additional specimens from Gruta del Garcia, Nuevo Leon, July 14, 1942, and Gruta Palmito, Bustamente, Nuevo Leon, July 17, 1942 (C. Bolívar, B. Osorio, D. Peláez, and F. Bonet, and Maldonado). Paratypes deposited in the collections of the American Museum of Natural History, Field Museum of Natural History, and in the personal collections of Drs. C. Bolívar and F. Bonet.

KAROS, NEW GENUS

Dorsum with five areas, the boundaries of which are parallel. First area without a median line. Dorsal scute and free tergites without median armature. Eye tubercle removed from the anterior margin of the cephalothorax, with paired spines. Tarsal segments: 4-7-6-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments. Femur of palpus with a median apical tubercle.

Genotype: *Karos barbarikos*, new species.

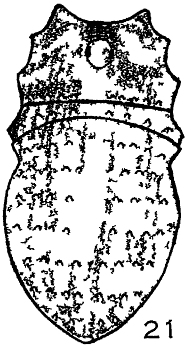
Karos is related to *Bishopella* Roewer, but has a different number of tarsal segments, lacks the elevation of the second area, and has a pair of small spines over the eyes.

Karos barbarikos, new species

Figures 13–15

Female: Total length of body, 2.5 mm. Cephalothorax, 0.8 mm. Width of body at widest portion, 1.7 mm.

	I	II
Trochanter	0.3 mm.	0.4 mm.
Femur	0.9	1.4
Patella	0.4	0.5
Tibia	0.6	1.1
Metatarsus	1.1	1.2
Tarsus	0.6	1.2
Total	3.9 mm.	5.8 mm.



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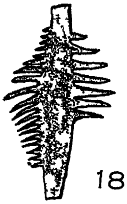

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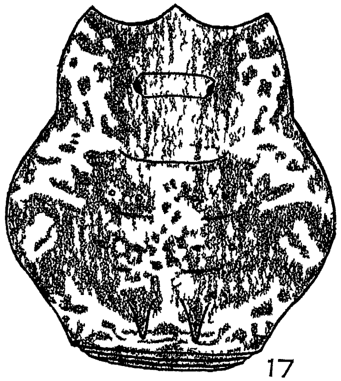

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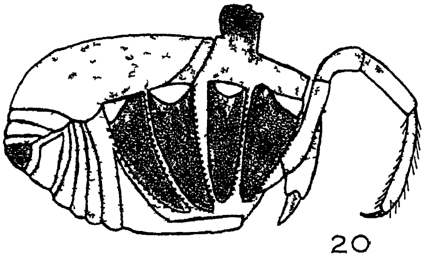

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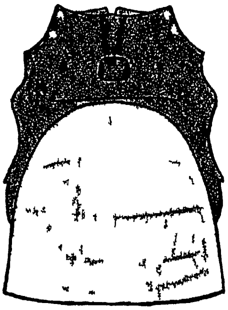

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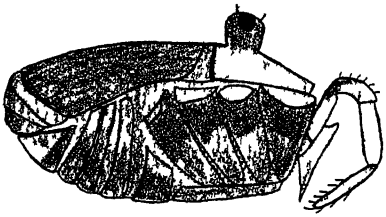

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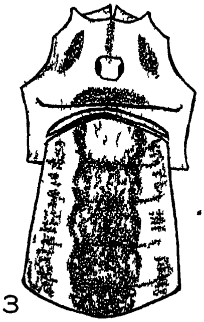

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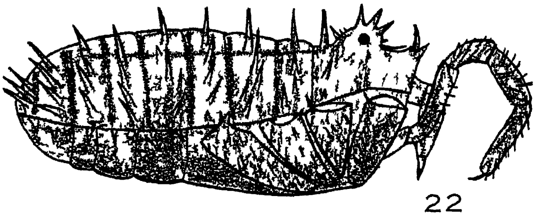

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Fig 17 *Bivonones gertschi* Goodnight and Goodnight, dorsal view of male
Fig 18 Idem, dorsal view of femur of fourth leg of male
Fig 19 *Romerella bicolor* new species, dorsal view of male
Fig 20 *Prionostemma wagneri* new species, lateral view of male
Fig 21 *Metopilio albispinulatus*, new species, dorsal view of male
Fig 22 *Metopilio multispinulatus*, new species, lateral view of male
Fig 23 *Leiobunum desertum*, new species, dorsal view of male
Fig 24 *Romerella catharina*, new species, lateral view of male

	III	IV
Trochanter	0.4 mm.	0.4 mm.
Femur	0.9	1.4
Patella	0.4	0.4
Tibia	0.9	1.2
Metatarsus	1.1	1.6
Tarsus	0.8	1.0
Total	4.5 mm.	6.0 mm.

Dorsum with five distinct areas, the boundaries of which are parallel. First area without a median line. First four dorsal areas thickly covered with tubercles. Fifth area and free tergites each with a transverse row of tubercles. Dorsal scute and free tergites without median armature, but with the median portion of the second, third, and fourth areas slightly elevated and with the tubercles very slightly enlarged. A lateral row of tubercles along the abdominal scute. Just posterior to the cephalothorax, the abdominal scute is somewhat widened; on either side of this lateral bulge is a light-colored tubercle. Cephalothorax relatively narrow, covered with granulations. Eye tubercle in the median portion, low, eyes at the base. A very small spine over each eye. Venter and coxae granulate, each free sternite with a small transverse row of tubercles. Genital operculum with thickly scattered tubercles. Spiracles visible.

Legs: clothed throughout with scattered hairs. All segments except the tarsus with numerous tubercles. These tubercles are especially large on the basal segments of the fourth leg. Metatarsi of all legs not divided into astragulus and calcaneus. Tarsal segments: 4-7-6-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments.

Palpus: trochanter, 0.4 mm. long; femur, 0.5; patella, 0.4; tibia, 0.4; and tarsus, 0.4. Total length, 2.1 mm. Armed retrolaterally as a figure 15. Prolaterally there is an apical median tubercle on the femur; two apical median tubercles and one small median tubercle on the patella, and four tubercles on the tibia and tarsus.

Chelicera: normal, proximal segment very slightly thickened, scattered hairs present.

Dorsum reddish brown, with dark brown mottlings on the cephalothorax. Central portion of the dorsal areas very dark brown, also lateral dark brown stripe on either side. Free tergites dark. Venter, coxae, and appendages reddish brown with much dark brown mottling. The entire animal is quite dark.

TYPE LOCALITY: Female holotype from Chapulhuacan, Hidalgo, May 10, 1942.

MONTERELLA, NEW GENUS

Dorsum with five distinct areas; the boundaries of the first and second areas are parallel. First area without a median line. All dorsal areas and free tergites without median armature. Eye tubercle removed from the anterior margin of the cephalothorax, unarmed. The femur of the palpus with a median apical spine. Tarsal segments: 4-more than 6-6-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments.

GENOTYPE: *Monterella tuberculata*, new species.

This genus is related to *Bishopella* Roewer, but has a different number of tarsal segments and lacks the elevation of the second area.

Monterella tuberculata, new species

Figures 1–3

MALE: Total length of body, 4.4 mm. Cephalothorax, 1.1 mm. Width of body at widest portion, 2.5 mm.

	I	II
Trochanter	0.4 mm.	0.4 mm.
Femur	1.6	2.5
Patella	0.8	1.0
Tibia	1.4	2.0
Metatarsus	1.7	2.2
Tarsus	1.2	2.6
Total	7.1 mm.	10.7 mm.
	III	IV
Trochanter	0.6 mm.	0.5 mm.
Femur	2.2	3.2
Patella	0.8	1.0
Tibia	1.7	2.3
Metatarsus	2.2	2.9
Tarsus	1.3	1.3
Total	8.8 mm.	11.2 mm.

Dorsum with five distinct areas, without median armature. First area without a median line, but the fourth area divided into two halves by a median furrow.

Boundaries of first and second, but not third and fourth, areas parallel. Median portions of first four areas thickly covered with tubercles. A transverse row of tubercles across the fifth area and each free tergite, and a light-colored tubercular bulge at the posterior lateral portion of the fifth area and first and second free tergites. A lateral row of tubercles on either side of the abdominal scute. On either side, just posterior to the cephalothorax, is a slight marginal bulge on which is located a light-colored tubercle. Eye tubercle in the median portion of the cephalothorax, without dorsal armature, low, eyes at the base. Scattered tubercles over the cephalothorax and the eye tubercle. Venter and coxae thickly covered with tuberculations. A transverse row of tuberculations across each free sternite. Spiracles hidden by the fourth coxae which are slightly expanded laterally.

Legs: clothed throughout with hairs· Trochanters, femora, and tibiae with numerous tuberculations which are larger on the fourth leg. Metatarsi not divided into astragulus and calcaneus. Tarsal segments: 4-7-6-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments.

Palpus: trochanter, 0.4 mm. long; femur, 1.3; patella, 0.9; tibia, 1.1; and tarsus, 0.8. Total length, 4.5 mm. All segments but the tarsus covered with tuberculations. Palpus armed retrolaterally as in figure 2. Prolaterally, the femur has a median apical spine, the patella has three spine bearing tubercles at the distal half, the tibia has four, and the tarsus has three.

Chelicera: normal, clothed throughout with tuberculations.

Dorsum light reddish brown, tuberculations slightly darker. Tuberculations at the lateral portion of the fifth area and first and second free tergites and at the bulge at the margin of the first area, yellowish. Venter and coxae concolorous with the dorsum. Appendages, except for the fourth leg, yellowish. Fourth leg reddish brown.

Type Locality: Male holotype from Chipinque, Monterrey, Nuevo Leon, July 15, 1942 (D. Peláez, C. Bolívar, F. Bonet, and B. Osorio).

Paramitraceras granulatus Cambridge

Figures 10–12

Paramitraceras granulatus Cambridge, 1904, Biol. Centr. Amer., Arach., vol. 2, p. 474, pl. 54, figs. 3, 3a, 3b. Roewer, 1923, Die Weberknechte der Erde, p. 117.

Male: Total length of body, 6.2 mm. Cephalothorax, 2.0 mm. Width of body at widest portion, 5.0 mm.

	I	II
Trochanter	0.7 mm.	0.6 mm.
Femur	2.3	3.6
Patella	1.1	1.4
Tibia	1.9	2.9
Metatarsus	2.1	3.7
Tarsus	1.3	2.2
Total	9.4 mm.	14.4 mm.

	III	IV
Trochanter	0.8 mm.	0.9 mm.
Femur	3.0	3.8
Patella	1.1	1.5
Tibia	2.3	2.9
Metatarsus	3.0	4.3
Tarsus	1.5	1.8
Total	11.7 mm.	15.2 mm.

Dorsum with five distinct areas, the boundaries of which are parallel. Each area thickly covered with tuberculations. Fifth area and free tergites, each with a transverse row of tubercles. First area without a median line. No median armature on any of the dorsal areas. The lateral portion of the abdomen in the region of the first area expanded into a rounded projection. Cephalothorax with a few tubercles just posterior to the eye tubercle. Eye tubercle on the anterior margin of the cephalothorax, in the form of a cone, wide at the base. Eye tubercle slants anteriorly, eyes at the base, scattered tubercles present. Venter and coxae tuberculate. Spiracle visible. A transverse row of tubercles across each free sternite. Anal operculum with scattered tubercles. First coxa with a transverse row of larger hair-tipped tubercles. Third coxa with lateral rows of teeth on the anterior and posterior margins. Fourth coxa strongly tuberculate, slightly widened laterally.

Legs: clothed throughout with hairs, all segments but the tarsi covered with tuberculations which are strongest on the femora. Tarsal segments: 3-4-5-5. Distitarsus of first tarsus with 2 segments; of second, 2 segments.

Palpus: trochanter, 0.8 mm. long; femur, 2.0; patella, 1.0; tibia, 1.5; and tarsus, 1.4. Total length, 6.7 mm. Palpus tuberculate, heavy, armed retrolaterally as in figure 12. Prolaterally the femur and patella are unarmed; the tibia has a distal bifid projection which is slightly larger than the corresponding retrolateral projection; tarsus with a spine at the proximal half.

Chelicera: enlarged. Distal segment with a slight dorsal elevation. Proximal segment tuberculate.

Entire animal reddish brown with darker brown mottlings. Appendages concolorous except for the tarsi of the legs which are light.

Record: Male from Triunfo, Chiapas, April, 1942 (H. Wagner).

COSMETIDAE Simon

Cosmetinae Cambridge

BIVONONES GOODNIGHT AND GOODNIGHT

Bivonones Goodnight and Goodnight, 1942, Amer. Mus. Novitates, no. 1163, pp. 2–3, figs. 14, 15.

Paired tubercules on the first and second areas, paired spines on the third. Remaining areas and free tergites unarmed. Tarsal segments: 6-remaining more than 6. Distitarsi of both first and second tarsi with 3 segments. Basal segments of third and fourth legs enlarged in the male.

Genotype: *Bivonones gertschi* Goodnight and Goodnight.

Additional material has enabled the writers to understand better the characteristics of this genus and species.

Bivonones gertschi Goodnight and Goodnight

Figures 17 and 18

Bivonones gertschi Goodnight and Goodnight, 1942, Amer. Mus. Novitates, no. 1163, pp. 2–3, figs. 14, 15.

Male: Total length of body, 6.9 mm. Cephalothorax, 3.0 mm. Width of body at widest portion, 6.5 mm.

	I	II
Trochanter	0.6 mm.	0.8 mm.
Femur	4.1	7.8
Patella	1.1	1.4
Tibia	2.7	6 0
Metatarsus	4.1	8 1
Tarsus	2 6	5 1
Total	15.2 mm.	29.2 mm.

	III	IV
Trochanter	1.0 mm.	1 1 mm.
Femur	5.9	6 3
Patella	1.9	1.9
Tibia	3.5	5.0
Metatarsus	5.9	7.7
Tarsus	3.0	3 2
Total	21.2 mm.	25.2 mm.

Dorsum finely granulate, a median pair of tubercles on the first and second areas and an additional tubercle laterad to each of the paired tubercles. Paired spines on the third area, a tubercle laterad and slightly anterior to each spine. Remaining areas and free tergites unbedecked. A transverse row of small tubercles across each free tergite. Scattered tubercles on the anal operculum. Eye tubercle large, a few small granulations over each eye. Venter and coxae covered with scattered tubercles and hairs. In addition, a transverse row of larger tubercles across the first coxae. A transverse row of tubercles across each free sternite.

Legs: with scattered hairs, tubercles present on the basal segments, particularly on the third and fourth legs. Basal segments of third and fourth legs enlarged. Fourth femur armed as in figure 18. The longer row of spines on the prolateral margin, a smaller row curved. Distal portion of third and fourth metatarsi slightly enlarged. Tarsal segments: 6-13-8-10. Distitarsi of tarsi of both first and second legs with 3 segments. The spines on the femur of the fourth leg of the holotype were not fully developed.

Palpus: trochanter, 1.3 mm. long; femur, 2.1; patella, 1.4; tibia, 1.9; and tarsus, 1.2. Total length, 7.9 mm. Palpus characteristically flattened, ventral teeth on the femur.

Chelicera: enlarged, proximal segment enlarged. Distal segment elevated.

Dorsum reddish brown, dark, with white markings as in figure 17. Tubercles and spines yellowish, a few scattered white spots on the free tergites and a large irregular white dot on the anal operculum. Venter, coxae, and chelicerae dark, legs and palpus light.

FEMALE: Total length of body, 7.2 mm. Cephalothorax, 2.7 mm. Width of body at widest portion, 7.0 mm.

Similar in appearance to the male, but with reduced chelicerae. Also the female lacks the spines of the fourth leg.

RECORD: Male and females from El Vergel, Chiapas, 200 meters, October, 1939 (C. Bolívar and D. Peláez).

BONETA, NEW GENUS

Dorsal scute with five areas. Third area with median tubercles. Remaining areas and free tergites without median armature. Third and fourth legs not enlarged over the first and second. Tarsal segments: 5-remaining more than 6. Distitarsi of both first and second tarsi with 3 segments.

GENOTYPE: *Boneta bilineata*, new species.

Boneta is related to *Poala* Goodnight and Goodnight, but differs in the number of tarsal segments.

Boneta bilineata, new species

Figure 16

MALE: Total length of body, 4.2 mm. Cephalothorax, 1.4 mm. Width of body at widest portion, 3.8 mm.

	I	II
Trochanter	0.5 mm.	0.5 mm.
Femur	1.8	3.3
Patella	0.6	0.6
Tibia	1 2	2.4
Metatarsus	1.8	3 2
Tarsus	1 3	2.8
Total	7.2 mm.	12.8 mm.

	III	IV
Trochanter	0.4 mm.	0.5 mm.
Femur	2.8	3.1
Patella	0.8	1.2
Tibia	1.8	2.6
Metatarsus	2.6	3.8
Tarsus	1 4	1 5
Total	9 8 mm.	12.7 mm.

Dorsum smooth, finely granulate. A pair of very low tubercles on the third area; in some specimens, they can be seen only with difficulty. A row of larger granulations present on the fourth area. Fifth area and each free tergite with a transverse row of tubercles. Venter and coxae finely granulate. A transverse row of small tubercles across each free sternite. Anal operculum with scattered tuberculations. Lateral portions of the fourth coxa tuberculate. A few lateral teeth present on coxa III.

Legs: clothed throughout with hairs. Femora, patellae, and tibiae with small tuberculations. Basal segments of third and fourth legs not enlarged. A few small tubercles at the distal portion of the trochanter of the fourth leg. Tarsal segments: 5-9-7-7. Distitarsi of both first and second tarsi with 3 segments. Basitarsus of first leg slightly enlarged.

Palpus: trochanter, 0.6 mm. long; femur, 0.8; patella, 0.5; tibia, 0.8; and tarsus, 0.4. Total length, 3.1 mm. Palpus characteristically flattened, with ventral teeth on the femur.

Chelicera: normal, with a few tuberculations on the proximal segment.

Dorsum reddish brown, with darker brown mottlings on the cephalothorax and the lateral and posterior portions of the scute. A small white V present at the junction of the cephalothorax and the abdomen. The arms of the V extend only a short distance. A transverse white line is present just posterior to the tubercles of the third area. A broken median line is sometimes present. Venter, coxae, and appendages reddish brown.

FEMALE: Total length of body, 4.5 mm. Cephalothorax, 1.3 mm. Width of body at widest portion, 3.3 mm.

Similar in appearance to male.

TYPE LOCALITY: Male holotype and male and female paratypes from Chipinque, Monterrey, Nuevo Leon, July 15, 1942 (D. Peláez, C. Bolívar, F. Bonet, and B. Osorio). Paratypes deposited in the collections of the American Museum of Natural History, Field Museum of Natural History, and in the personal collection of Drs. C. Bolívar and F. Bonet.

Poala granulosa Goodnight and Goodnight

Poala granulosa GOODNIGHT AND GOODNIGHT, 1942, Amer. Mus. Novitates, no. 1211, pp. 6, 7, fig. 13.

RECORD: Zempoala, Morelos, 2800 meters, May 31, 1942 (C. Bolívar).

SUBORDER PALPATORES THORELL

PHALANGIIDAE Simon

Leiobuninae Banks

Leiobunum desertum, new species

Figure 23

MALE: Total length of body, 3.3 mm. Cephalothorax, 1.1 mm. Width of body at widest portion, 1.7 mm. Length of femora: I, 6.1 mm.; II, 9.4 mm.; III, 6.1 mm.; IV, 8.8 mm.

Dorsum smooth, eye tubercle slightly canaliculate, smooth above. Supracheliceral lamella in the form of an expanded plate. Venter and coxae smooth; lateral teeth on the anterior margins of coxae I to III and a few on the anterior margin of coxa IV. Teeth present on the posterior margin of coxa IV.

Legs: clothed throughout with scattered hairs and with a few scattered small black spines on the basal segments.

Palpus: trochanter, 0.4 mm. long; femur, 0.9; patella, 0.5; tibia, 0.6; and tarsus, 1.1. Total length, 3.5 mm. Palpus clothed throughout with hairs. A few scattered small black spines on all segments. Patella without apophyses.

Chelicera: normal, with scattered hairlike spines.

Dorsum brownish, with a darker brown median stripe outlined in a lighter color. Eye tubercle with a lighter median stripe, darker brown mottlings on the median portion of the cephalothorax. Entire dorsum thickly covered with light punctations. Venter and coxae light, with brownish mottlings. Trochanters and bases of femora with much darker brown markings, thus appearing to contrast with the coxae. Remainder of legs brownish, somewhat lighter than the trochanters. Palpi light, with darker brown markings on the dorsal portion, particularly on the femur and patella. Chelicerae concolorous with the venter.

FEMALE: Total length of body, 3.7 mm. Cephalothorax, 1.3 mm. Width of body at widest portion, 1.8 mm.

Identical in appearance with the male.

TYPE LOCALITY: Male holotype and male and female paratypes from Santa Rosa, D. F., November 24, 1941 (H. Wagner). Additional paratypes from Desierto de los Leones, D. F., September 18, 1941 (H. Wagner). Paratypes deposited in the collections of the American Museum of Natural History and in Field Museum of Natural History.

This species is related to *L. potosum* Goodnight and Goodnight, differing in the dorsal color pattern.

Leiobunum potosum Goodnight and Goodnight

Leiobunum potosum GOODNIGHT AND GOODNIGHT, 1942, Amer. Mus. Novitates, no. 1211, p. 9, fig. 21.

RECORD: Santa Rosa, D. F., November 20, 1942.

Paranelima lutzi Goodnight and Goodnight

Glabrurus lutzi GOODNIGHT AND GOODNIGHT, 1942, Amer. Mus. Novitates, no. 1163, p. 14, fig. 21.

Paranelima lutzi GOODNIGHT AND GOODNIGHT, 1942, Amer. Mus. Novitates, no. 1211, p. 11.

RECORD: Crater del Nevado de Toluca, Mexico, 4100 meters (C. Bolívar).

Phalangiinae Simon

Metopilio albispinulatus, new species

Figure 21

MALE: Total length of body, 3.6 mm. Cephalothorax, 1.0 mm. Width of body at widest portion, 2.2 mm.

	I	II
Trochanter	0.4 mm.	0.4 mm.
Femur	2.2	3.9
Patella	0.8	1.2
Tibia	1 9	3.3
Metatarsus	2 0	2 3
Tarsus	4.0	9 1
Total	11.3 mm.	20.2 mm.
	III	IV
Trochanter	0.4 mm.	0.4 mm.
Femur	1.9	3.2
Patella	0.8	0.9
Tibia	1.7	2.2
Metatarsus	2.2	3.2
Tarsus	4.5	6.0
Total	11.5 mm.	15.9 mm.

Dorsum finely granulate, thickly covered with minute black granulations. Eye tubercle low, with several very minute spines scattered over the dorsal portion, not canaliculate. Median anterior elevation of the cephalothorax with a few small spinules on either side and an unspined median line. A transverse row of from 8 to 12 small spinules across each of the abdominal segments and the posterior two thoracic segments. The spines of the same height across the entire row. The venter and coxae with scattered, small, spine-like hairs. Coxae without lateral teeth.

Legs: basal segments, femora, patellae, and tibiae of legs I and III somewhat enlarged over II and IV. A few small spines present on the basal segments of legs II and IV. These are black. Larger scattered spines present on the first and third legs, particularly at the distal portions of the segments. Metatarsi of the second and fourth legs, each with one false articulation; tibiae also with one.

Palpus: trochanter, 0.3 mm. long; femur, 0.6; patella, 0.4; tibia, 0.6; and tarsus, 1.1. Total length, 3.0 mm. Palpus clothed throughout with hairs. Spines present on the ventral portion of all segments.

Chelicera: normal, thickly clothed with hairs.

Dorsum dark brown, with some lighter mottlings. A light, narrow, brown median stripe crosses the eye tubercle and extends to the median portion of the abdomen where it becomes obscure. Transverse rows of dorsal spines light, giving a punctate appearance. Venter light brown, with dark brown mottlings. Coxae dark. Legs dark reddish brown. Palpi and chelicerae dark.

FEMALE: Total length of body, 4.2 mm. Cephalothorax, 1.4 mm. Width of body at widest portion, 2.2 mm.

Identical with male, but lighter in color, obliterating the distinct dorsal stripe of the darker colored male.

TYPE LOCALITY: Male holotype and female paratypes from Cuernavaca, Morelos, September, 1941 (H. Wagner). Paratypes in the collection of the American Museum of Natural History.

M. albispinulatus differs from other species of the genus *Metopilio* by having the median line of the median elevation of the cephalothorax unspined, and in having uniformly sized spines.

Metopilio multispinulatus, new species

Figure 22

MALE: Total length of body, 3.2 mm. Cephalothorax, 1.2 mm. Width of body at widest portion, 2.0 mm.

	I	II
Trochanter	0.5 mm.	0.5 mm.
Femur	1.8	3.9
Patella	0.7	1.0
Tibia	1.8	3.5
Metatarsus	1.9	2 5
Tarsus	2.4	5.1
Total	9.1 mm.	16.5 mm.
	III	IV
Trochanter	0.4 mm.	0.4 mm.
Femur	1.9	2.8
Patella	0.6	0.7
Tibia	1.5	1.9
Metatarsus	2.2	2 8
Tarsus	2.4	3.2
Total	9.0 mm.	11.8 mm.

Dorsum elongate, thickly covered with rough granulations. Anterior margin of the cephalothorax with a median elevation which has three or four large, and several small, spines on either side. A median smooth line between these groups of spines. Eye tubercle rounded, not canaliculate, with five or six large spines and several small ones irregularly arranged on the dorsal surface. Posterior to the eye tubercle is a transverse row of eight irregularly spaced spines. The last segment of the cephalothorax and each abdominal segment with a transverse row of 8 to 15 large, irregularly spaced spines. The spines of the posterior segments of the abdomen are somewhat larger; although the spines are more or less arranged in rows, there is much variation. On the dorsal half of the anal operculum are large spines. Venter smooth, with a few small, scattered, black spines. Genital operculum and coxae thickly covered with small black spines. Second maxillary lobes slanted and spined. Coxae without lateral teeth.

Legs: clothed throughout with hairs. Femora, patellae, and tibiae much heavier than the metatarsi and tarsi. First and third legs slightly heavier than the second and fourth. Trochanters, femora, patellae, and tibiae of all legs thickly armed with large, black-tipped spines. A few larger light spines at the distal portion of these segments. Tibiae somewhat angular. Metatarsus of second leg with 2 false articulations.

Palpus: trochanter, 0.4 mm. long; femur, 0.4; patella, 0.3; tibia, 0.4; and tarsus, 0.6. Total length, 2.1 mm. Palpus clothed throughout with hairs, all segments except the tarsus thickly covered with small black spines. Tarsal claw small and smooth.

Chelicera: normal, armed with small black spines.

Dorsum brownish, mottled, eye tubercle dark brown with an indefinite lighter median stripe. Median portion of the abdomen with indefinite lighter marking beginning as a very narrow stripe just posterior to the eye and gradually widening to the posterior portion of the abdomen. Median spines of the last two rows light. Venter and coxae light brown except for small black spines. A series of pale spots on the sternites. Trochanters, metatarsi, and tarsi of legs light brown. Remainder of legs darker brown. Palpus light brown, mottled dorsally with darker. Chelicerae light, with black-tipped claws.

FEMALE: Total length of body, 3.9 mm. Cephalothorax, 1.2 mm. Width of body at widest portion, 2.5 mm.

Identical in appearance with the male.

TYPE LOCALITY: Male holotype and female paratypes from Oaxtepec, Morelos, May 17, 1942 (C. Bolívar). Paratypes in the collection of the American Museum of Natural History and in that of the collector.

Gagrellinae Thorell

Prionostemma wagneri, new species

Figure 20

MALE: Total length of body, 2.1 mm. Cephalothorax, 0.9 mm. Width of body at widest portion, 1.6 mm. Length of femora: I, 10.2 mm.; II, 17.2 mm.; III, 9.5 mm.; IV, 13.7 mm.

Dorsum smooth, eye tubercle canaliculate with a few very small tubercles over the anterior portion of each carina. Supracheliceral lamella in the form of an expanded plate with a sharp spine at the median border. Dorsum somewhat arched. Venter and coxae granulate. Coxae with scattered larger granulations. Anterior margins of coxae I to IV and posterior margin of coxa IV with three-pronged teeth.

Legs: long, hair-like, covered with scattered hairs. Nodules: 0-3-0-1. Nodules small. Metatarsi with false articulations.

Palpus: trochanter, 0.4 mm. long; femur, 0.9; patella, 0.4; tibia, 0.4; and tarsus, 1.1. Total length, 3.2 mm. Palpus with a few scattered hairs. A ventral row of very small spines on the femur. Patella with a very short median apical apophysis.

Chelicera: normal, with scattered hairs.

Dorsum golden, shining, with a few indistinct darker mottlings. A spot of dark brown on the median portion of the free tergites and anal operculum. Eye tubercle, except at the base, dark brown to black. Venter and genital operculum golden. Coxae, trochanters, and bases of femora, dark brown to black, contrasting vividly. Remainder of legs brownish. Palpus and chelicera yellowish; cheliceral claws tipped with black.

FEMALE: Total length of body, 3.0 mm. Cephalothorax, 1.3 mm. Width of body at widest portion, 2.1 mm.

Identical in appearance with male.

TYPE LOCALITY: Male holotype and male and female paratypes from Prusia, Chiapas, 1000 meters, March 4, 1942 (H. Wagner). Paratypes in the collection of the American Museum of Natural History. Another paratype from Atoyac, Vera Cruz, July 14, 1941 (H. Dybas), in the collection of Field Museum of Natural History.

Prionostemma wagneri differs from other species of the genus in the color of its dorsum.

Romerella bicolor, new species

Figure 19

MALE: Total length of body, 3.5 mm. Cephalothorax, 1.0 mm. Width of body at widest portion, 2.0 mm. Length of femora: I, ?; II, 21.0 mm.; III, 11.1 mm.; IV, 14.4 mm.

Dorsum smooth, eye tubercle slightly canaliculate, constricted at the base, smooth above. Eye tubercle towards the posterior portion of the cephalothorax. Supracheliceral lamella in the form of an expanded plate. Venter and coxae granulate. Some lateral teeth present on the anterior and posterior margins of all coxae.

Legs: long and slender, a few scattered hairs throughout. Metatarsi with false articulations. Nodules: ?-4-0-1.

Palpus: trochanter, 0.3 mm. long; femur, 1.0; patella, 0.6; tibia, 0.6; and tarsus, 1.3. Total length, 3.8 mm. Palpus clothed throughout with hairs, a few very small tubercles on the ventral portion of the femur. Patella without an apophysis.

Chelicera: normal, clothed throughout with hairs.

Cephalothorax and eye tubercle dark, shining metallic, a few light spots at the anterior median margin of the cephalothorax. Dorsal portion of the abdomen golden, some darker brown flecks present. Posterior segments with a few indefinite dark spots between them. Free sternites brownish. Genital operculum darker brown. Coxae, trochanters, and bases of femora very dark brown to black. Remainder of legs dark brown, but lighter than the trochanters. Palpus white, chelicera white except for the black tips on the claws. Anterior mouth parts white. This white anterior portion of the animal contrasts strongly with the remainder of the body.

TYPE LOCALITY: Male holotype from Catharinas, Chiapas, 1400 meters, May 10, 1942 (H. Wagner).

Romerella bicolor differs markedly from the other species of the genus in the distinctive color pattern of the dorsum.

Romerella catharina, new species

Figure 24

MALE: Total length of body, 3.4 mm. Cephalothorax, 1.4 mm. Width of body at widest portion, 1.6 mm. Length of femora: I, 12.7 mm.; II, 22.5 mm.; III, 12.7 mm.; IV, 13.9 mm.

Dorsum finely granulate, eye tubercle towards the posterior portion of the cephalothorax, slightly canaliculate, smooth above, constricted at the base. Supracheliceral lamella in the form of an expanded plate. Venter and coxae finely granulate. A few lateral teeth present on the anterior and posterior margins of all coxae. These are very small and difficult to observe.

Legs: long and slender, clothed throughout with hairs. Small black spines on the femora. Metatarsi with false articulations. Nodules: 0-4-0-1.

Palpus: trochanter, 0.4 mm. long; femur, 1.3; patella, 0.4; tibia, 0.7; and tarsus, 1.1. Total length, 3.9 mm. Palpus clothed throughout with hairs, a few small spines present on the ventral portion of the femur. Patella without an apophysis.

Chelicera: normal, with the basal portion of the last segment slightly elevated. Clothed throughout with hairs.

Dorsum brownish, more or less mottled darker and lighter, metallic, giving a shiny appearance. Eye tubercle concolorous except for a darker ring around each eye. Venter and coxae very dark brown. Distal portions of the coxae, trochanters, and the bases of the femora almost black, remainder of the legs brown with some lighter mottlings. Palpus yellowish with some darker mottlings on the distal portion of the femur and on the patella. Chelicera and frontal region yellowish, tips of cheliceral claws black.

FEMALE: Total length of body, 6.1 mm. Cephalothorax, 2.1 mm. Width of body at widest portion, 3.3 mm.

Similar in appearance to male.

TYPE LOCALITY: Male holotype and female paratypes from Catharina, Chiapas, May 4, 1942 (H. Wagner). Paratypes in the collection of the American Museum of Natural History.

Romerella catharina differs from the other members of the genus in its distinctive color pattern.

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THE SEXUAL BEHAVIOR OF ANURA

6. THE MATING PATTERN OF *BUFO AMERICANUS*, *BUFO FOWLERI*, AND *BUFO TERRESTRIS*[1], [2]

BY LESTER R. ARONSON

INTRODUCTION

The mating activities of many species of the genus *Bufo* are relatively better known than are those of most other species of Anura. This is due to three major reasons: (1) the relative abundance of many *Bufo* species, (2) the ease with which they may be studied in the field or captured during and after the breeding season, and (3) the slow rate at which their sexual activity declines when kept in captivity. There are, nevertheless, a number of confusing and contradictory statements in the literature dealing with the sexual activity of toads which call for elucidation. The purpose of this study was to investigate the sexual behavior of *Bufo americanus* and related species, particularly those phases which lent themselves to laboratory research.

Bufo americanus was found to be most suitable for this study, and this species was used for the longer experiments and more extensive observations. Shorter comparative observations were made on the other two species, *Bufo fowleri* and *Bufo terrestris*.

Most of the experiments were conducted during the 1940 breeding season under the guidance of the late Dr. G. Kingsley Noble.

MATERIALS AND METHODS

The American toads were collected in various localities in New York State and New England during April and May. The Fowler's toads all came from Long Island, mostly from Long Beach, and a few from the vicinity of Middle Village. The southern toads were purchased from a dealer in Englewood, Florida, during May. They were kept in large wire cages containing earth, sand, gravel, damp moss, and pans of water, and were fed daily with blow flies (*Calliphora*) and meal worms (*Tenebrio*). Fowler's toads were heavily parasitized, and a large number of them died. *B. americanus* and *terrestris* were much more viable, but the females of the latter species were least active sexually.

The female American toads ovulated spontaneously. Some Fowler's toads ovulated after homoplastic pituitary injections (Rugh, 1935). Only one partial ovulation of *Bufo terrestris* was obtained after pituitary treatment. It is probable that most of the latter species were collected shortly after breeding and the ovaries had not developed sufficiently when the pituitary injections were started. That pituitary implantations are ineffective in *Rana pipiens* immediately after the breeding season has been noted by Rugh (1937).

Most of the tests (except where noted) were conducted in glass-walled slate or mirror-bottomed aquaria, 30 cm. × 40 cm. × 25 cm. filled to a depth of approximately 4 cm. with water at room temperature. A few stones, twigs, and pieces of

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[2] The author wishes to express his appreciation to Dr. Frank A. Beach for reading the manuscript and for many helpful criticisms. The assistance of Miss A. Meyerson and Mr. H. Dugas in making the observations is acknowledged. The figures were drawn by Miss P. Hutchison.

straw in the water completed the set-up. At first the observations were conducted in a dark room with a dim red light for illumination, but it was soon discovered that the toads reacted equally as well in broad daylight. Thereafter no attempt was made to darken the testing room.

Further details on methods will be given in the description of the experiments which follow.

VOICE

Three distinct calls were recognized in the males of the species studied, namely, the sex trill, the chirp, and the warning vibration. As contrasted with *Rana pipiens* (Noble and Aronson, 1942), these three vocalizations were so distinct that it was almost impossible to confuse them. There were, in addition, slight variations in the homologous calls in the three species studied, so that after some experience it was possible to identify the species on the basis of any one of the three calls.

The fright cry heard in many species of *Rana* (Boulenger, 1897; Dickerson, 1906; Noble and Farris, 1929; Noble and Aronson, 1942) was never heard during this study. It has been described by Wright and Wright (1942) as occurring rarely in *B. terrestris*.

The females of the species studied are mute. This is apparently a general characteristic of the genus, as no reports were found of any female *Bufo* ever vocalizing. When the observer held a female by its back, markedly increased respiratory (thumping) motions were often noted. In the male, these respiratory changes were associated with the chirp and warning vibrations, but in the female no sound resulted. Savage (1934) noted a similar response in *Bufo bufo*. Many gravid females did not exhibit these respiratory exaggerations.

Male Sex Trill

The sex call or trill of the male is the well-known voice which is heard in the ponds during the toad breeding season. It is the primary component of the toad chorus. This call has been described adequately in the literature (Dickerson, 1906; Wright, 1914, 1932; Wright and Wright, 1942; Blair, 1942), and no further description is required here. The sex call is seasonal. It is sounded most frequently at the height of the breeding period; as the season progresses it is sounded less and less frequently, and after the season it is seldom heard. Environmental factors, particularly rain and changes in temperature, are believed to stimulate the sex call of the male during the breeding season (Bragg, 1941).

The function of the sex call in *Bufo* has been described as attracting the female as well as other males (Courtis, 1907; Miller, 1909; Wellman, 1917; Noble, 1931; Savage, 1934; Locher, 1939; and Bragg, 1940, 1941). It has been pointed out by Bragg (1942) that in some species of Anura, e.g., *Bufo cognatus*, there is apparently a delayed response of the females to the calls of the male which may amount to several hours or days. Experiments by Blair (1942) indicated that given the choice of two choruses of related species (*B. woodhousii* and *B. americanus*), males and females were attracted to a limited extent by the call of their own species.

Various species of *Rana* will call while floating, spread out on the surface of the water (Bragg and Smith, 1942), or while swimming towards a female (Noble and Aronson, 1942). In contrast to this, the toads under consideration were never observed to call while floating or swimming, and always stopped calling before clasping a female.

Male Chirp

The chirp is the familiar sound which is elicited when the back of the male is touched. It is approximately the pitch of the sex trill, but of much shorter duration, and is repeated continually until the "annoyance" ceases. If the "annoyance" lasts for a long time, the chirping sometimes ceases for short intervals. Chirping is often accompanied by a partial inflation of the vocal sac. The function of the chirp is not known. It is not effective in causing a clasping male to release the chirper (see section on sex recognition and discussion).

MALE WARNING VIBRATION

This call is readily elicited whenever the back of a male is stimulated. It is a dull, vibratory, barely audible sound, which can be heard only if the toad is held within a few inches of one's ear. On the other hand, if one touches the back of a vibrating toad the vibrations can easily be felt. This vibration functions independently of the vocal cords, since we found that severance of the latter did not eliminate the vibration. The physiological mechanism involved is not known. It is suggested that the accentuated respiratory movements cause the entire arytenoid cartilage to vibrate, and these vibrations are transmitted through the body musculature. This warning vibration is very effective in causing a second clasping male to release immediately (see section on sex recognition).

Both the chirp and the warning vibration are seasonal and were less readily elicited after the breeding season, the warning vibration being the more persistent of the two. Listed in order of disappearance after the season, the sex trill is first, the chirp second, and the warning vibration last. Sickness, inanition, and other disturbing factors also caused the vocalizations to disappear in the above-named order.

It should be noted that the chirp and warning vibration were elicited by the same stimuli, but the chirp was generally the less easily evoked of the two. Stimuli adequate to elicit the chirp always brought forth the warning vibration, but the converse did not hold, particularly towards the end of the season.

RESPONSE OF A MALE TO A CLASP OBJECT

In the experiments on *Rana pipiens* previously reported (Noble and Aronson, 1942) it was demonstrated that within the limits of an experimental situation sexually active males did not exhibit any discrimination of males, females, or pairs at a distance as shown by attempts at clasping. Since investigators claiming such discriminatory reactions utilized species of the genus *Bufo* for their observations, it was deemed advisable to repeat this experiment. Hinsche (1926) claimed that male *Bufo vulgaris* responded to certain motions peculiar to the female. Savage (1934) credited the male *Bufo bufo* with the ability of recognizing a pair. " . . . The lower member is certainly a female . . . A male which attacks a pair has some chance of dislodging his rival. Both the capacity for recognizing a pair and the advantage of attacking it seem to exist."

For the experiment herein reported a large aquarium was used, 110 cm. × 50 cm. × 31 cm., filled with water to a depth of 8 cm. at 23° C. The room was darkened and the tank was illuminated from above by a single 25-watt bulb. The following American toads were introduced: three pairs, three gravid females, and three sexually inactive males. A sexually excited male (experimental male) was now selected (one forcibly separated from a female) and introduced into the tank. The number of times the experimental male attempted to clasp males, females, or pairs was recorded. Attempts at clasping females were often successful, in which case the newly formed pair was separated. When the attempt was made to clasp a pair, the observer reported whether the action was directed towards the male or female of the pair. When the responses of the experimental male showed a reduced frequency, he was replaced by another active individual. Each trial was conducted for 20 minutes.

The results of the experiment are summarized in table 1. It should be noted that this is a record of attempts at amplexus, and no distinction was made between successful and unsuccessful endeavors. If the experimental males chose at random between the three clasp objects, the percentage of times that they clasped each clasp object would be 33.3, and for 409 trials the standard error, $\epsilon(p)$ of this *a priori*

TABLE 1

DISTANCE DISCRIMINATION OF PAIRS, MALES, AND FEMALES, BY SEXUALLY EXCITED MALES AS SHOWN BY ATTEMPTS AT CLASPING

Trial	Total number of attempted clasps	Number of times male tried to clasp				
		Pairs			Males	Females
		Male of pair	Female of pair	Total for pairs		
1	54	21	7	28	13	13
2	43	13	2	15	12	16
3	44	19	1	20	20	4
4	35	13	0	13	8	14
5	37	18	0	18	13	6
6	24	3	1	4	8	12
7	22	7	1	8	10	4
8	30	21	0	21	4	5
9	61	32	0	32	10	19
10	33	10	0	10	14	9
11	26	7	1	8	10	8
	N = 409	M% = 96.8	M% = 3.2	Σ = 177 = 43.3%	Σ = 122 = 29 8%	Σ = 110 = 26.9%

$\epsilon(p)$ = standard error of a 33.3% *a priori* random probability.

$$\epsilon(p) = \pm\sqrt{\frac{33\ 3 \times 66.7}{409}} = \pm 2.3\%.$$

random probability would be ±2.3 per cent. The actual percentages of times that the males clasped males or females fell within two and one-half times the standard error, and hence no significant deviation from the expected ratio was indicated. The percentage of times that pairs were clasped was greater than $3\epsilon(p)$, indicating a slight but significant preference for the pairs. Thus the observation of Savage (1934) that there is a greater tendency for males to select pairs is substantiated. On the other hand, this experiment contradicts Savage's conclusion as to the relative advantage of attempting amplexus with a pair. It will be noted that of the 177 attempts to clasp pairs, 96.8 per cent were directed to the male of the pair, and all ended in failure. Of the 3.2 per cent of the attempts to clasp the female of the pair, only two clasps (0.5 per cent) were successful. Of these one was on the ventral side of the female. In the second case the new suitor still had the task of displacing the original possessor, and the intruding male showed no particular advantage in the lengthy struggle that ensued.

As Courtis (1907) and Hinsche (1926) had previously noted, the motions (activity) of the pairs, males, and females appeared to be the most important factor in attracting the male providing, of course, that the clasp objects were near enough to be visible. In this experiment the pairs were generally most active, the males next, while the females often rested quietly on the bottom.

While this experiment was not repeated on *Bufo fowleri* and *terrestris*, observations indicated that a very similar mechanism existed in these species.

SEX RECOGNITION

The literature contains suggestions that the sex discriminatory mechanism is not an efficient one, that males are frequently found clasping other males, or the males of pairs (Liu, 1931; Rugh, 1935). To examine this question, the results of the attempts at amplexus of the previous experiment were tabulated. When the clasp was successful, two minutes were allowed to elapse before the pair was forcibly

TABLE 2

RESULTS OF ATTEMPTS AT AMPLEXUS WITH MALES, FEMALES, AND WITH BOTH MEMBERS OF A PAIR

Clasp object	Total number of attempts	Per cent of attempted amplexus showing: Immediate release*	Slow release**	Forcibly separated***
Male of pair	164	100 0	0 0	0 0
Female of pair	13	84 6	0 0	15 4
Separate male	110	100 0	0 0	0 0
Separate female	122	25 4	5 7	68 9

* Within 10 seconds. ** Between 10 seconds and 2 minutes. *** After 2 minutes.

separated. Release was considered immediate if it occurred within ten seconds. Releases occurring between ten seconds and two minutes were recorded as slow releases. The results of this experiment are indicated in table 2. Of the 164 attempts of the experimental males to clasp males of pairs, and of the 110 attempts of the experimental males to clasp separate males, all (100 per cent) resulted in the immediate release of the clasp object. In contrast to this, 68.9 per cent of the 122 attempts of the experimental males to clasp females were successful, and the newly formed pairs had to be forcibly separated. Of the 13 attempts to clasp the females of pairs, only two trials (15.4 per cent) were successful. This experiment demonstrates clearly the efficiency of the discriminatory mechanism which functions after amplexus has been attempted.

To investigate further the mechanisms involved in post-amplexus sex recognition (the discrimination of a male from a female after amplexus is attempted), a series of experiments were performed using the 30 cm. × 40 cm. × 25 cm. test tanks. In these experiments the clasp object was modified in various ways, so as to eliminate one by one the possible factors which might cause a male attempting amplexus to release. In this manner it was possible to "highlight" the effective mechanism, and at the same time to eliminate, or at least to reduce in importance, certain factors which heretofore were considered important in sex recognition. Each of these experiments was repeated at least ten times on *Bufo americanus* with similar results, and was repeated several times on the other two species. The sexually active experimental males used in the following experiments were first allowed to clasp females for at least five minutes. They were forcibly separated from the females just before being tested with various clasp objects.

Exp. 1: A male was injected intraperitoneally with 5 cc. of physiological saline solution, thus increasing his girth to approximately that of a fat female. This treatment did not affect the chirp or the warning vibration of the injected male. A sexually active experimental male (just separated from a female as noted above) was placed in a tank with the saline-injected male. The experimental male attempted amplexus several times with the saline-injected male, but released immediately after each attempt. From this experiment it is concluded that increasing the girth of a male in order to approximate that of a gravid female does not enable a sexually active male to maintain his clasp.

Exp. 2: A spent female was now introduced into a test tank. This female had recently laid a large complement of eggs and was thinner than the average male. A sexually active experimental male was placed in the tank with the spent female. Amplexus soon occurred and lasted for 20 minutes when the male was forcibly separated. Hence, reducing the girth of a female is ineffective in causing a clasping male to release.

Exp. 3: A male was anaesthetized by immersion in a 3 per cent solution of urethane. This treated male did not move and could not be stimulated to sound the chirp or warning vibration. A sexually active experimental male was now placed in the tank with the anaesthetized male, and the latter was pushed around by the observer until the experimental male clasped. Amplexus was maintained for about 20 minutes. At this time the urethane began to wear off, and the treated male began to sound the chirp and warning vibration.

As a supplement to experiment 3, a dead male was placed in a tank with an experimental male, and the body was pushed around by the observer until the sexually active male clasped. Amplexus was maintained until the two were forcibly separated after a half hour. From these experiments it is concluded that some reaction not present in a dead or anaesthetized male stimulates a clasping male to release. Moreover, the effective physiological mechanism is probably the chirp or warning croak (or both).

Exp. 4: A male was muted by cutting the vocal cords. This operation eliminated the chirp but not the warning vibration. An experimental male was introduced into a tank with the muted male. The sexually active male attempted amplexus several times but released immediately each time. Of the two physiological factors suggested by the previous experiment, it is now evident that the warning vibration alone may be an effective stimulus for release.

Exp. 5: A male was partially anaesthetized by immersing it in a urethane solution for a short time. This treatment eliminated the chirp but not the warning vibration. When the experimental male was introduced he attempted amplexus several times but released immediately each time. Again it is concluded that the warning vibration alone may be the effective factor causing a clasping male to release.

Exp. 6 (*Bufo americanus* only): A male was wrapped in several layers of crepe paper. Following this procedure, the male chirped almost continuously, but the warning vibration could not be felt through the wrappings by the observer. A sexually active male was now placed on the wrapped male, and despite the chirping and the awkward shape of the clasp object, amplexus lasted over 15 minutes. It is now concluded that the chirp is not effective in causing a clasping male to release and that the warning vibration alone is the effective factor.

Exp. 7: An experimental male was induced to clasp the female of a pair by wedging himself between the original male and the female. The pectoral regions of both males were in contact with the back of the female. The hind limbs of the original male rested on the head and back of the newcomer, thereby stimulating the second male to chirp and give a more or less continuous warning vibration. The observer then touched the back of the original male so that now both males chirped and gave the warning vibration. Both males remained clasping until forcibly separated after a half hour. This experiment indicates that the effective warning vibration is not an auditory stimulus but a tactual one, and the effective region of the clasping male for the reception of the stimuli is apparently the ventral pectoral area and the inner surfaces of the forelimbs.

Exp. 8: The observer firmly held the hind limbs of a male and placed the animal on the surface of the water in an observation tank. An experimental male was introduced and attempted amplexus many times with the restrained male. Immediate release followed each attempt. The observer then tried placing the experimental male on the restrained male, but the former would not clasp. Liu (1931), Savage (1934), and Locher (1939) have postulated a "repulsive action" which is a characteristic of the male. According to these authors a male will struggle and try to dislodge a second clasping male, while the females are passive and will permit a clasping male to retain his clasp. The present results indicate that the "repulsive action" is not a major factor in sex recognition, since a restrained male was quickly released.

The results of the above series of experiments are summarized as follows:

(1) Differences in girth among a gravid

female, a spent female, or a male are not factors in post-amplexus sex recognition.

(2) The chirp does not function in this capacity.

(3) The warning vibration of the male is the only apparent mechanism by which a male distinguishes a female from another male after amplexus is attempted.

(4) Although the warning vibration can be heard and felt by the observer, the clasping male responds primarily to tactual stimulation (not to auditory stimulation), and the region of the clasping toad sensitive to these stimuli is the ventral pectoral region plus the medial surfaces of the forelimbs.

AMPLEXUS

As already noted by Wright (1914, 1932), amplexus was either axillary or supra-axillary. According to our observations the type of clasp seemed to depend on the relative sizes of the male and female. In figure 1 it is clearly supra-axillary. Some of the *Bufo terrestris* females used were more than twice the size of the males. In these cases the clasps were all supra-axillary. Where the male and female were of the same size, axillary clasps usually resulted.

The hind limbs of the male were fully flexed, and the male's abdomen adhered closely to the back of the female, his back arched convexly. The tip of the male's mouth generally reached the transverse level of the eyes of the female. For excellent illustrations of various clasping *Bufo*, the reader is referred to Roesel von Rosenhof (1758, pl. 20), Boulenger (1897), Wright (1914), Hinsche (1926), Wright (1932), Savage (1934), Rugh (1935), and Bragg (1937).

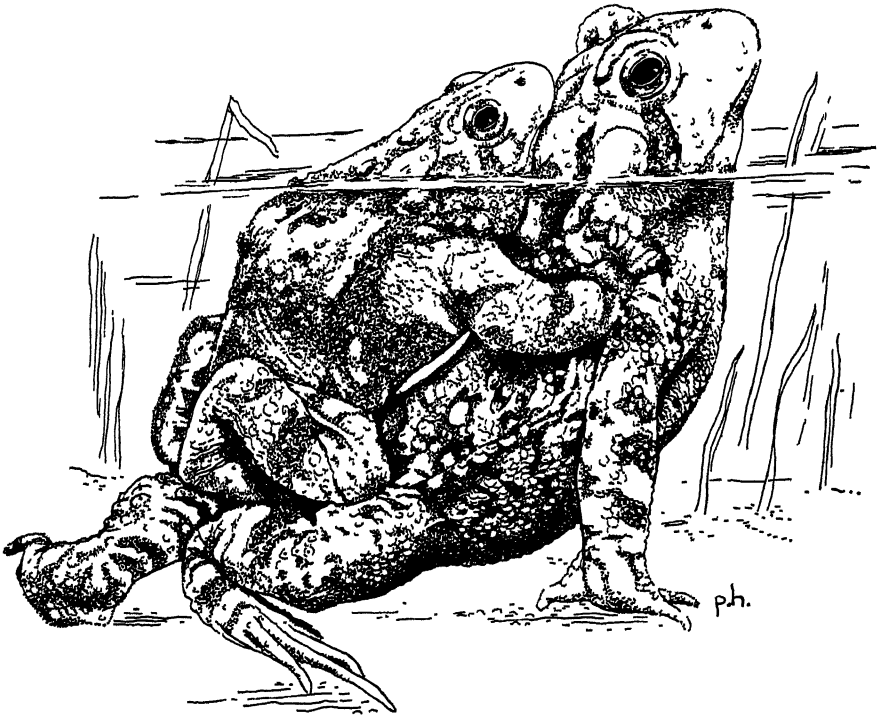

Fig. 1. *Bufo americanus* pair exhibiting the back-arch release mechanism.

OVIPOSITION

Descriptions of the egg-laying process in various species of the genus *Bufo* are numerous and date far back in biological literature. Roesel von Rosenhof (1758) described in considerable detail and with an excellent colored plate the oviposition of a toad which he called *Bufo terrestris, dorso tuberculis exasporato, oculis rubris* (probably *Bufo bufo bufo*). He also wrote a brief description of the oviposition of *Bufo terrestris foetidus* (*Bufo calamita*). Similar descriptions of the spawnings of these two species were presented by Spallanzani (1785) and Héron-Royer (1885, 1886). Boulenger (1897) described the oviposition of *Bufo vulgaris* (probably *Bufo bufo bufo*); Miller (1909) and Wright (1914) reported on the oviposition in *Bufo americanus;* Wright (1932) witnessed the spawning of *Bufo terrestris;* Liu (1932) reported on *Bufo raddei*, while Rostand (1934) and Savage (1934) described anew the egg laying of *Bufo bufo bufo* including certain new interpretations.

These descriptions reveal that the mode of oviposition is remarkably similar in these species of *Bufo* as contrasted with the divergent mechanisms of spawning in *Rana* and *Hyla*.

The following description of the oviposition of *Bufo americanus*, though somewhat repetitious, is presented in an attempt to clarify some of the discrepancies in the literature. It is based upon a series of spawnings of *Bufo fowleri* and *Bufo americanus* and one partial spawning of *Bufo terrestris*. No differences were noted in the egg-laying behavior of the three species.

Pre-oviposition activity (during amplexus but prior to the actual spawning) consisted of (1) a slightly increased restlessness on the part of the female, and (2) peristaltic-like contractions of the female's abdominal muscles. These very characteristic movements generally occurred as a series of from three to twelve waves over a period of a few minutes. In most cases they started posteriorly, simultaneously on both sides, and travelled anteriorly. Occasionally they occurred alternately, first on one side and then on the other. On a few occasions they were noted to start anteriorly and to travel caudally. Following these contractions, the female generally moved to a new location.

The pre-oviposition period varied from a few minutes to many hours. It was followed by the oviposition or in some cases by a period of pseudo-oviposition (see p. 10) before the actual egg deposition started. The female always started the egg laying by arching her back concavely and by extending her hind limbs caudally (fig. 2), thighs pointed outward, legs inward, heels close together, or touching at the midline, and toes pointed outward. Thus a diamond-shaped enclosure was formed by the female's hind limbs. This position resembled to a limited extent the oviposition posture of female *Rana pipiens* (Noble and Aronson, 1942) and *Rana septentrionalis* (Aronson, 1943).

Immediately following this movement of the female, the male arched his back convexly and partially extended his hind limbs, knees pointed downward and slightly forward, resting on the outer surface of the female's thighs. The legs pointed medially and dorsally; the ankles pointed upward, the heels downward, while the toes pointed ventrally and extended under the female's cloaca. The exact position of the male's knees and toes varied somewhat, apparently depending on the size relationship of the male and female. The resemblance of the male's position to the oviposition posture of a female *Rana pipiens* is very striking. The result of this posturing of the male and female was that their cloacas were brought into juxtaposition.

The female's abdominal wall now contracted (as a whole and not like the peristaltic movements described above), and a clump of eggs issued from her cloaca. Almost simultaneously the male's abdominal walls showed three or four brief ejaculatory contractions. The egg mass often remained for a few minutes just behind the male and female's cloacas, supported by the toes of the male. Then, sliding over the latter, they fell within

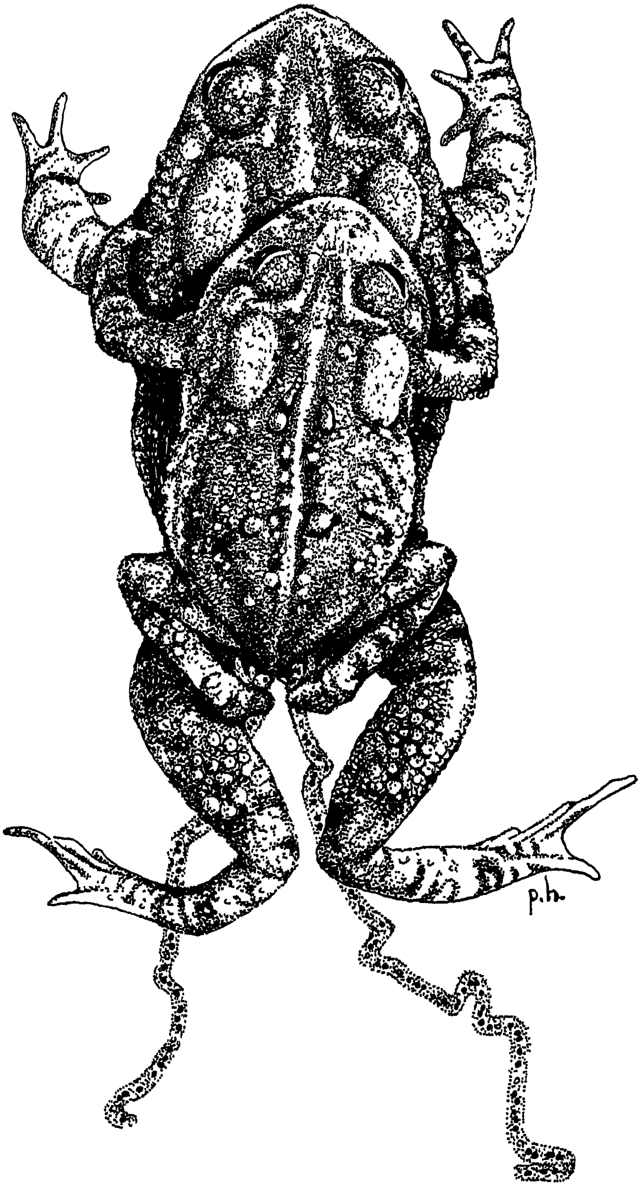

Fig. 2. Oviposition of *Bufo americanus*.

the diamond-shaped enclosure formed by the female's hind limbs.

The female then gradually spread her heels apart and soon assumed her normal crouching position followed by a similar action of the male. The female now moved about from place to place for two to ten minutes, spreading out the eggs and thus revealing their arrangement in two strings.

One end of each of the strings was free, while the other ends extended into the female's cloaca. A series of peristaltic contractions, as described above, now followed, and a new oviposition cycle was started. These cycles sometimes lasted less than a minute and usually occurred every three to ten minutes. During some of these spawning cycles the male and female remained in the oviposition posture for a number of minutes after the extrusion of the eggs. In such cases the peristaltic waves often occurred while the pair were in this posture, and it sometimes happened that a second egg extrusion started before the pair moved from the egg-laying posture.

The duration of two complete spawnings was recorded. One (*Bufo americanus*) lasted three hours and thirty minutes. The other (*Bufo fowleri*) took five hours and ten minutes. Some of the spawnings of all three species were of a multiple type. That is, the egg string broke (ovulation apparently ceased), and the male released the female. Then, after a variable length of time, the female was reclasped by the same or a different male, and the egg laying was resumed. In one case, two such interruptions were noted.

RELEASE

The release of the female by the male at the termination of the spawning was observed in *Bufo americanus* on three occasions. The release, which will be described below, is representative of the other two occasions where this behavior was witnessed.

A female who had laid a small part of her eggs during the night was placed in an observation tank with a sexually active male at 10 A.M. Amplexus occurred almost immediately. At 10:25 A.M. the first oviposition cycle occurred, and similar cycles recurred at intervals of three to ten minutes until 11:35 when the last typical cycle was noted. At 11:40 another oviposition cycle started, but very few eggs were laid, and the egg chains broke. At 11:45 another oviposition cycle took place, which was typical in every respect, including the male's ejaculatory contractions, except that no eggs were emitted. At 11:47 another cycle started. No eggs were emitted; but this time the female arched her back severely (fig. 1), much more than in the typical spawning cycle, and the male was partially lifted off the back of the female. The male immediately released his clasp of the female. Within one minute the male reclasped the female. Thirty seconds later an oviposition cycle was started, no eggs appeared, the female arched her back severely, and the male released. This reclasping and release was repeated a second time within the next two minutes.

In the second case the male started calling immediately after releasing the female, and this vocalization continued until he reclasped the female. Three post-spawning reclasps and releases were witnessed with this pair.

The reaction of several recently spent females (spawned within the preceding 48 hours) to clasping males was studied. The males readily maintained tight clasps upon these females. After intervals of two to fifteen minutes, oviposition cycles occurred, the females arched their backs severely (no eggs were laid), and the males released after from one to five cycles. Thus far this back-arch release mechanism has been noticed only in recently spent females. When males clasped unovulated females or females that spawned one or two months previously, no release behavior was elicited even after many hours or days in amplexus.

PSEUDO-OVIPOSITION

Bufo fowleri and *Bufo terrestris* females were injected with two to four homoplastic anterior pituitary bodies, in an attempt to induce ovulation. In many cases ovulation did not occur, but when these females were placed in tanks with active males, the females were clasped, and pseudo-oviposition often took place. Pseudo-oviposition differed from normal oviposition in the following respects: (1)

peristaltic contractions of the female's abdominal walls were seldom evident; (2) no eggs were extruded; (3) the pseudo-oviposition cycles generally occurred at far less frequent intervals (15 minutes to one hour) than the normal oviposition cycles, and (4) the back-arch release mechanism did not appear.

DISCUSSION

Sex Recognition

Although reports of males maintaining clasps on other males have been made frequently (Liu, 1931; Rugh, 1935), our results indicate that this is not a general procedure of male toads in captivity. Moreover, field observations usually refer to only a few such pairs (Wright, 1914), whereas there are often hundreds or thousands of male toads located in a small breeding area. Nevertheless, some explanation of these "mistakes" is necessary. It was pointed out that the warning vibration of the male, which is the all-important mechanism in sex recognition, becomes weaker or disappears completely as a result of sickness, inanition, or the passing of the breeding season. It is probable that such males are the ones that are clasped. Examination in the laboratory of pairs consisting of two males invariably showed that the clasped male was not sounding the warning vibration, and after the pair was separated the warning vibration was never elicited when the investigator touched the back of the formerly clasped male.

When toads are confined to laboratory habitats, weaknesses, and sickness are exaggerated. Toads so affected will rapidly lose their warning vibration, and because of crowded conditions it is not long before they are clasped by the healthier toads. It is not surprising, therefore, to find some males being clasped by other males. We feel that this is the explanation for the statement by Rugh (1935) that sexually aroused male toads show a lack of discrimination by maintaining amplexus with other male toads, whereas male frogs show no such lack of discriminatory powers. If one wishes to compare the sexual discriminatory ability of our local *Bufo* and *Rana*, it must be concluded that the toads are at least as well equipped for the task as are the frogs.

The literature on the mechanism of sex recognition in *Rana* has been reviewed recently by Noble and Aronson (1942). In this genus the warning croak and girth of the toad being clasped are the major factors involved. This is probably true for most species of the genus, but according to Savage (1934) a totally different discriminatory mechanism is found in *Rana temporaria.*

Investigators working with various species of *Bufo* (Miller, 1909; Liu, 1931; Savage, 1934; and Locher, 1939) with the exception of Hinsche (1926) are in agreement that the relative girths of the male and female are not factors in sex discrimination. The present study confirms this conclusion. The above authors (Hinsche again excepted) are also in agreement that the warning voice or chirp is a very important factor. In none of these studies has the distinction been made between the chirp and the warning vibration. From the descriptions of the voice and the allusions to auditory functions, it is presumed that these workers were referring to the chirp. We have found, to the contrary, that the chirp is not an effective mechanism in causing a clasping male to release; this function is carried out by the barely audible warning vibration, and it is clearly not an auditory but a tactile response. Owing to the close relation of the warning vibration and chirp, it is clear how confusion might have arisen. Our conclusions are limited to the three species under investigation.

Yerkes (1905), while studying the sense of hearing in frogs, could not find any motor reactions resulting directly from auditory stimulation. By experimentation he found that sounds will modify reactions resulting from visual or tactual stimuli. The release of a vibrating male is clearly the result of tactual stimuli. It is possible that the sound of the chirp reenforces this motor action of release. This might conceivably be revealed by more refined measurements of the release time.

A "repulsive action, a kind of dodging dive which males alone display when seized" (Savage, 1934) has also been postulated as a secondary discriminatory factor by Liu (1931) and Locher (1939). We have noticed that both males and females tended to struggle when clasped, but we have been unable to observe any sexual differences in this behavior which could be effective in the sex discriminatory mechanism. Considering the immediate effectiveness of the warning vibrations in cases where the clasped male was restrained by the observer (exp. 8), any "repulsive actions" which might normally be present would have to be relegated to a very minor role.

Hinsche (1926) recognized the importance of tactual stimulation for the maintenance of amplexus, but his interpretation of its function is just the opposite of that given here. This author believed that the roughness of the skin, the pulsations of the flanks, and peculiar locomotion are factors characteristic of a female and which will induce a clasping male to retain his clasp. However, these differential structures and habits are not clearly demonstrated, and it is hard to conceive of any slight differences between the sexes which might exist as the major factors in this relatively efficient mechanism of sex recognition. Hinsche's investigation was orientated mainly towards the problem of why males will sometimes maintain lengthy (many days) clasps on inanimate objects, frogs, salamanders, etc. Here such factors as girth, shape, plasticity, and skin texture undoubtedly play much more important parts.

OVIPOSITION

It is apparent that some of the differences in the descriptions of the egg layings which are found in the literature are due to species variations. Thus the females of the three species considered in this report all formed diamond-shaped enclosures with their hind limbs, while in the European species the females apparently extend fully their lower extremities.

The omissions of the peristaltic contractions in the descriptions of some of the more recent authors (Boulenger, 1897; Miller, 1909; Wright, 1914, 1932; and Savage, 1934) were probably due to incomplete observation or reporting, since other authors observing the same species have found this behavior to be very characteristic. Indeed, the earlier authors Roesel von Rosenhof and Spallanzani described these abdominal contractions in very vivid terms, and the latter author ventured the opinion that these contractions were concerned with ovulation and with the passage of the eggs down the oviduct.

The observations made by Roesel von Rosenhof (1758), Miller, (1909), Wright, (1914, 1932) and verified in the present report, that when the male's feet are hooked behind the female's cloaca they form a basket for the retention of the eggs, are vigorously denied by Savage (1934). This author points out that when the pair was supported by weeds away from the substratum (as generally occurs in the ponds) such retention of the eggs would not occur. However, during the present observations, straw and weeds were plentiful and the pair was often supported by them; yet the "baskets" were often in evidence. The presence or absence of these "baskets" was apparently due to size differences of the male and female, since the position of the male's toes during oviposition and hence the ability of the toes to support the eggs would depend upon this size ratio.

The interpretations of Héron-Royer (1886) and Boulenger (1897), that the male helps to draw the eggs out of the female, have already been refuted by Miller (1909), Rostand (1934), and Savage (1934), and the present study supports this denial.

Savage (1934), in discussing the oviposition of *Rana temporaria*, stated that the stimulus for the male ejaculation is the contact of the outcoming eggs with the pubic region of the male. Likewise for the common toad the contact of the outcoming eggs with the male's toes was considered by Savage as the adequate stimulus for the ejaculation by the male. Noble and Aronson (1942) have shown that this explanation was not satisfactory for *Rana pipiens*. In the present study ejaculatory movements were observed during pseudo-oviposition, when no eggs were present to act as a stimulus. The work with *Rana pipiens* suggested that the egg-laying movements of the female stimulated the ventral pectoral region of the male to cause the ejaculation. The present study indicates that a similar mechanism is present in the *Bufo* under consideration.

Release after Oviposition

Savage (1934) pointed out that the mechanism whereby the male releases the female at the termination of the oviposition might very well differ in those Anura that lay their eggs in a relatively short period of time as compared to those frogs and toads whose oviposition lasts an hour or more. We have also found this to be the case, although our interpretations of the release mechanisms differ from those of Savage. A review of the various explanations of the release after oviposition in Anura follows.

Noble and Farris (1929), working with *Rana sylvatica*, hypothesized that the reduction in girth of the female was the responsible factor. Savage (1934), studying *Rana temporaria*, added the reappearance of the warning croak to the hypothesis of Noble and Farris. However, our observations on a number of American *Rana* indicated that the warning croak of the female generally does not return for several hours after the spawning. Noble and Aronson (1942), observing *Rana pipiens*, suggested the stimulus for release was probably the resultant of a number of factors including (1) the ejaculations of the male, (2) reduction in girth of the female, (3) cessation of the female oviposition reflexes, and (4) movement of the female from the egg-laying posture.

Returning to the toads, Liu (1931) noted that in *Bufo raddei* (as well as in *Rana nigromaculata*) there was a peculiar stretching movement of the female's body which caused the male to release. Savage (1934) claimed that the break in the egg strings—that is, the break in a chain of reflexes which require at a certain point the stimulus of eggs touching the male's toes—causes the male to release.

Hyla andersonii deposit their eggs during an extended series of oviposition cycles. It was noted by Aronson (1944) that when the eggs ceased to flow, still another oviposition cycle occurred. During this cycle, the female arched her back severely, the male was partially raised from the back of the female and released two seconds later. We have found the same back-arch release mechanism in the *Bufo* under consideration. That the presence or absence of eggs is not the important factor was indicated by our extended pseudo-ovipositions, some of which lasted a whole day without the male releasing. It seems likely that the peculiar stretching of the female noted by Liu is a modified form of this release mechanism.

SUMMARY

1. Three distinct vocalizations are recognized in the male toads, namely, the sex trill, the chirp, and the warning vibration. These calls are seasonal, being most easily elicited at the height of the breeding season. After the season they disappear in the following order: sex trill first, chirp second, and warning vibration last.

2. In an experimental situation, sexually active male toads do not discriminate at a distance between other males or females but attempt to clasp members of either sex with equal frequency. There is, however, a slight tendency to clasp pairs more frequently than individuals, the clasps in these cases being directed almost entirely to the male of the pair. This preference for pairs is probably due to greater activity on the part of the pairs.

3. The sex-recognition mechanism (discrimination of a male from a female after amplexus is attempted) is found to be very efficient. The mechanism depends almost exclusively on the warning vibration of a male being clasped. These vibrations act as tactual stimuli of the ventral

pectoral region and medial surfaces of the forelimbs of the clasping male, causing him to reject the clasp object. Females do not emit these vibrations, and therefore the clasping male maintains amplexus. Relative girths of male and female, relative "repulsive actions" of both sexes, and the male's chirp are found not to be efficacious in sex recognition.

4. The positions and movements of the male and female during the oviposition are described in detail.

5. Release of the female by the male at the termination of the oviposition follows a severe concave arching of the back of the female, which partially lifts the male off the female.

6. Pseudo-oviposition (oviposition movements without the deposition of eggs) can sometimes be induced in anterior pituitary injected but unovulated females when clasped by males.

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THE GENERA OF CORVIDAE AND THEIR RELATIONSHIPS

BY DEAN AMADON

This paper summarizes a study of the genera of Old World Corvidae undertaken while arranging the collection of the American Museum of Natural History. For completeness the few exclusively New World genera are included. There has been no comprehensive survey of this family since Sharpe's (1909), and many important modern regional lists such as that of Hellmayr (1934) are uncritical in their treatment of genera. Ridgway's (1904) work on the North American genera, while eminently sound, entailed a degree of genus splitting which often obscures relationships. The only species not available to me were *Cyanocitta* (*"Cyanolyca"*) *nana* and *mirabilis*, *Cyanocorax dickeyi*, and *Zavattariornis stresemanni;* the latter is the only genus not examined. My field experience is limited to the genera *Cractes*, *Cyanocitta*, *"Aphelocoma,"* *Gymnorhinus*, *Pica*, *Nucifraga*, and *Corvus*.

The plan of this paper is similar to that of a preceding one on the Sturnidae (1943, Amer. Mus. Novitates, no. 1247) in which I gave my reasons for favoring the present trend towards a broad genus concept. Some might prefer the use of subgenera for certain of the lesser groups. Since subgeneric names are indistinguishable in form from generic ones, use of the former, as Dunn (*in* Bogert, *et al.*, 1943, p. 131) recently pointed out, seems to tempt later authors to elevate them to generic status. Accordingly, formal use of subgenera has here been avoided, but where a section of a genus has commonly been referred to under a generic name the latter is used in the discussion, but in quotation marks to indicate that it is not considered to be a valid genus. In other cases, sections of genera are referred to under the name of the included species that was first described. Type species of generic names are given in parentheses after the name of the author. Generic synonyms given include only those with different type species.

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LIMITS OF THE FAMILY CORVIDAE

Although some vertebrate zoologists have thought that the Passeriformes could all be united in a single family, ornithologists have divided this order into 50 or more families. Even so, many aberrant genera have been included in various families at the risk of making them polyphyletic (cf. Mayr, 1943). A compromise involving reduction of some of the present families to subfamilies and their subsequent combination into larger families will probably be the best eventual solution. A beginning was made by Hartert (1910) when he reduced the babblers, thrushes, Old World flycatchers, and Old World warblers to the status of subfamilies of the Muscicapidae. Another group of closely allied subfamilies can similarly be gathered in the Corvidae. It is beyond the scope of this paper to decide which groups will be included in such an enlarged family Corvidae. They will be essentially what Sharpe (1877, p. 4) called Group Coliomorphae: Corvidae, Paradisaeidae, Oriolidae, Dicruridae, Prionopidae. The Prionopidae probably do not belong here, while the Cracticidae and perhaps others are to be added. Accordingly, the Corvidae as generally understood is here considered to be a subfamily, Corvinae. It is true that this group has been divided by some ornithologists into two subfamilies, the Corvinae and Garrulinae, chiefly on the extremely variable and trivial character of tail/wing proportions. Ridgway (1904, p. 204, footnote) although accepting this division, expressed doubt as to whether these groups are actually of subfamily rank. The jays, magpies, nutcrackers, and crows are closely related and agree in all important morphological characters and even in many minor ones, as well as in characteristic behavior patterns.

Hartert (1910, p. 1) and Ridgway (1904, pp. 252–254) give definitions of the Corvidae (Corvinae) which may be consulted by those interested. In general the group is characterized by large size of the included species; nasal bristles; large, strongly scutellated tarsi, booted behind; large tenth (outer) primary; and by a few prevailing types of coloration. The behavior of the Corvinae is equally diagnostic. The following traits are usually present: long-continued courtship feeding; nest building and feeding of young by both male and female; incubation and brooding by female only; burying or hiding of food; breaking of food with the bill while the food is held in the feet; loud and usually harsh notes; omnivorous and more or less predatory feeding habits; bold and inquisitive nature.

Of the genera here included in the Corvinae, the only ones concerning whose allocation there can be any serious doubt are *Platylophus* and possibly *Ptilostomus* and *Zavattariornis*. Life history rather than anatomical studies may well furnish conclusive evidence as to the affinities of these genera.

Stonor (1942) has shown that the New Zealand genera *Callaeas*, *Heteralocha*, and *Philesturnus*, which have sometimes been considered members of the Corvidae, are best considered a separate family, the Callaeidae. It will perhaps prove possible to consider this a subfamily of the Corvidae in the broad sense, for I doubt if the special relationship formerly postulated between *Heteralocha* and *Philesturnus* and the Sturnidae exists.

Two anomalous Australian genera, *Struthidea* and *Corcorax*, may be allied to the Callaeidae, as several authors have suggested. At any rate they are probably members of the Corvidae in the broad sense, but almost certainly do not belong to the typical Corvinae as here understood. Even if their resemblance to the Callaeidae does not prove to be significant, they are probably more closely related to other subfamilies of the Corvidae occurring in the Australian region than to the Corvinae.

Struthidea and *Corcorax* are sometimes placed in different families, but their similarity in habits (Gould, 1865, pp. 470–473) and in the more conservative features of external morphology leaves little doubt in my mind that they are related and may be placed in a single subfamily, Corcoracinae. The differences between *Struthidea* and *Corcorax* parallel those between *Callaeas* and *Heteralocha* to some extent but are less striking.

Since *Corcorax*, like the chough (*Pyrrhocorax*), is large, black, and has a curved bill it received the common name of white-winged chough. Shufeldt (1923) compared skeletons of the two genera and concluded that they are closely related. I am convinced that he was mistaken. Since reliable osteological characters useful in taxonomy are scarce among closely related birds such as comprise the entire order Passeriformes, Shufeldt concentrated upon plastic, adaptive "habitus" characters such as the shape of the bill and associated parts of the skull. Parallelism in such characters was often erroneously considered by Shufeldt to indicate true relationship. He concluded that *Corcorax* is allied to *Pyrrhocorax;* that *Cyanocephalus* is a link between the jays and such icterids as *Sturnella*, and that since *Struthidea* has a heavy bill it is profitable to compare it with the neotropical finch *Saltator*. The extreme improbability that the semi-terrestrial *Corcorax* of the Australian bush should have as its closest ally the strong-flying *Pyrrhocorax* of the alpine regions of Eurasia was ignored by Shufeldt, as were many differences in the morphology and habits of the two genera.

The curious West African genus *Picathartes*, which contains two geographically representative species of so-called bald crows, certainly does not belong in the Corvinae and doubtfully in the Corvidae. Elsewhere (1943) I have given reasons opposing Lowe's (1938) suggestion that *Picathartes* is a starling. The habits of the bald crows suggest to me that they may be a very aberrant offshoot of the thrush-babbler assemblage (Walker, 1939).

Although behavior is useful in delimiting the Corvinae as a group from structurally similar subfamilies such as the birds of paradise, great caution must be used in interpreting differences in behavior among members of the Corvinae. A few examples will make this apparent. The Florida race of *Cyanocitta* ("*Aphelocoma*") *coerulescens* is as bold and confiding as a Canada Jay (*Cractes*), while the Great Basin race *woodhousei* is furtive and shy. The three species of "*Aphelocoma*" as usually understood, *coerulescens*, *sordida*, and, *unicolor*, are morphologically very similar, except for variation in wing/tail proportions. Yet *coerulescens* lays spotted eggs, most of its notes are harsh, and it is only moderately gregarious, while *C. sordida* is very gregarious, has a peculiar finch-like call, and lays blue, unspotted eggs. Less is known of the third species, *unicolor*, but it inhabits humid cloud forests (Dickey and Van Rossem, 1938, p. 409), while the other two live in subarid regions. There is also considerable variation in the behavior of some species of the genus *Corvus*. The jackdaw, *C. monedula*, unlike the others, nests usually in hollows of trees or of buildings and lays an egg rather unlike that usual in this genus. *C. typicus* of Celebes was found by Heinrich to be so unlike most crows in voice and habits that Stresemann (1940, p. 16) suggested leaving it in a monotypic genus, but it is so closely related to various other species of *Corvus* of the East Indian region that this procedure is hardly acceptable. *Podoces humilis* nests in rodent burrows and lays white eggs while its congeners build nests in bushes and lay spotted eggs, though some of them occasionally nest in burrows.

VARIABLE CHARACTERS

The Corvinae, though by no means so plastic as their relatives, the birds of paradise, are a variable group. The relative lengths of wing and tail are especially variable, often even in closely related species, as will be apparent from examination of table 1. Since wing and tail lengths often vary independently, the ratio of tail/body and wing/body is given in addition to the usual tail/wing ratios to permit variation in wing and tail to be studied separately. Body length as used here was obtained by subtracting the tail length from the total length, the latter taken from skins, and serves to give a very rough ndex to general size. The measurements of North American species are from Ridgway (1904), of *Cyanocorax dickeyi* from Moore (1935), of *Zavattariornis* from Moltoni (1938), and of the others from specimens in the American Museum.

One or two examples of variability illustrated in the table may be mentioned. *Kitta chinensis* and *thalassina*, while specifically distinct, are so similar that Chasen (1935, p. 310) called them subspecies of each other. Yet the relative tail length differs greatly. *Cyanocitta coerulescens* has a relatively much shorter wing than the otherwise morphologically similar *sordida* and *unicolor*.

The crest is also extremely variable in the Corvinae. For example, in the *beecheii* superspecies of *Cyanocitta* ("*Cissolopha*"), *san-blasiana* has a prominent frontal crest absent in the other three species of the group. The remarkable range of structure in the crest exhibited by various species of the genus *Cyanocorax* is described in the discussion of that genus below.

Of the 19 genera here recognized no

SPECIES	TAIL/WING	TAIL/BODY	WING/BODY	BODY
Platylophus galericulatus	86	69	81	180 mm.
Garrulus glandarius	83	92	110	175
" *lanceolatus*	111	106	96	155
" *lidthi*	111	114	113	180
Cyanocitta cristata	98	94	96	137
" *coerulescens insularis*	110	99	90	150
" *sordida*	87	95	111	153
" *unicolor*	95	99	104	156
Gymnorhinus cyanocephalus	74	72	97	159
Cyanocorax violaceus	83	78	94	212
cristatella	73	79	108	190
heilprini	100	90	90	195
chrysops	111	96	86	175
mystacalis	109	107	98	145
dickeyi	95	—	—	—
luxuosa	130	125	96	138
Calocitta formosa	161	171	79	179
Kitta thalassina	87	85	98	143
" *chinensis*	145	136	94	165
" *whiteheadi*	113	124	110	200
" *erythrorhyncha*	200	205	103	190
Platysmurus leucopterus	110	122	112	173
Ptilostomus afer	172	166	97	165
Podoces biddulphi	72	61	86	177
Nucifraga columbiana	60	63	105	186
Zavattariornis stresemanni	93	100	107	135
Pyrrhocorax pyrrhocorax	56	70	126	220
Corvus corax	56	61	109	402

TABLE 1. Proportions and body lengths of some species of the Corvinae. The body length is given to supply a rough index to general size.

fewer than eight are monotypic. Three of the eight monotypic genera are so distinct and aberrant that there is some question whether they belong to the Corvinae (*Platylophus*, *Zavattariornis*, *Ptilostomus*). Despite the large percentage of monotypic genera, the average of about five species per genus is fairly satisfactory.

Corvidae

CROWS, BIRDS OF PARADISE, OLD WORLD ORIOLES, ETC.

Corvinae

CROWS, MAGPIES, JAYS, NUTCRACKERS, ETC.

PLATYLOPHUS SWAINSON (GALERICULATUS)
SHRIKE JAY

SPECIES: 1, *galericulatus*.

RANGE: Malay Peninsula, Sumatra, Java, Borneo.

DIAGNOSIS: Plumage brown or black with white crescents on the sides of the neck; a few of the occipital feathers greatly elongated and broadened near their tips, thus forming a large crest; nasal bristles sparse and short; rictal bristles exceptionally long; tip of mandible more hooked than in other jays; bill otherwise like that of *Garrulus*.

REMARKS: *Platylophus* has usually been considered a member of the Laniidae, but this is evidently incorrect. Bartels and Stresemann (1929, p. 136) place it in the Corvidae and state that its habits and nidification are jay-like but give no details. More evidence is needed.

Of the three Old World genera of jays, one is boreal, one temperate, and the present one tropical, in distribution. I do not consider this an argument against allocation of *Platylophus* to the jays, as the New World jays are concentrated in the tropics. Probably other jays once existed in the tropics of Asia but have been displaced by the more specialized magpies. *Platylophus*, though in some respects aberrant, may be primitive. Partly to express this and partly because knowledge of *Platylophus* is still insufficient, it is placed at the beginning of the Corvinae.

CRACTES BILLBERG (PERISOREUS AUCT.) (INFAUSTUS)
CANADA JAY, ETC.

SYNONYMS: *Boanerges* Thayer and Bangs (*internigrans*).

SPECIES: 1, *internigrans;* 2, *infaustus* (including *canadensis* and *obscurus*, considered by some to be specifically distinct).

RANGE: Boreal regions of Northern Hemisphere, south in the mountains to western China and California.

DIAGNOSIS: Color varying from black to grayish white, sometimes rufous; plumage soft and fluffy; bill rather short and somewhat depressed.

REMARKS: The interesting *internigrans* of the mountains of western China suggests *Garrulus lanceolatus* of the Himalayas in its bill and black head. Though it is larger and has relatively stronger bill and legs than *infaustus*, it is unnecessary to recognize *Boanerges*, as Stegmann and others have already concluded. The unspecialized appearance of *Cractes* may be in part secondary adaptation to its boreal habitat, but the genus is rather primitive. The resemblance of *internigrans* to *Garrulus* and the occurrence of both species of *Cractes* in Asia leave little doubt that it is an Old World genus which reached America recently, later than the other American jays.

GARRULUS BRISSON (GLANDARIUS)
EUROPEAN JAY, ETC.

SYNONYMS: *Laletris* Reichenow (*lanceolatus*); *Lalocitta* Reichenow (*lidthi*).

SPECIES: 1, *glandarius;* 2, *lanceolatus;* 3, *lidthi.*

RANGE: Palaearctic region and Amani-Oshima and Tokuno-shima Islands, Ryu Kyu Group, south of Japan (*lidthi*).

DIAGNOSIS: Alula and sometimes remiges and rectrices blue barred with black; body plumage reddish or vinaceous; wings and tail bluish black; size large for jays.

REMARKS: As compared with *glandarius*, *lidthi* is specialized in the following respects: size larger; bill coarser, less upturned; coloration brighter; remiges and rectrices tipped with white; throat feathers lanceolate; tail relatively longer (table 1). The third species, *lanceolatus* of the Himalayas, is intermediate in almost every respect. The specialization of *lidthi* is, it would seem, to be attributed to its isolation on two small tropical islands. The three species obviously comprise a natural group comparable with other genera of jays; this is concealed and nothing gained by placing each of the three in a monotypic genus. That *lidthi* is more specialized and magpie-like than *glandarius* seems to me self-evident. Sushkin (1927), however, reached the surprising conclusion that *lidthi* is a primitive species representing stock ancestral to both the New and Old World jays and surviving on segments of a former intercontinental land bridge which he called Behringia. This suggestion seems to have been based upon theories concerning land bridges rather than upon the actual characters of *lidthi*.

Jahn (1942, pp. 79–82) found *lidthi* to be essentially like *glandarius* in habits, except that it nests in holes in trees. A substantial nest is built, and one or two nests have been found in the open in thick cover —indications that the hole nesting of *lidthi* is of recent origin. The number of eggs laid is less than in *glandarius;* this may represent the reduction usual in tropical species rather than an adjustment to lack of enemies as Jahn suggests. The eggs of *lidthi*, unlike those of *glandarius*, are unspotted and blue. This variation in egg color is similar to that existing between *Cyanocitta sordida* and other species of *Cyanocitta*.

The colored map of the distribution of the various forms of *Garrulus* which forms the frontispiece of Wallace's "Island life" (1881) is still of interest. Since then some of the forms have been subdivided into minor subspecies; it has been learned that the true home of *lidthi* is the Ryu Kyu Islands, not southern Japan, and that the only member of the genus which overlaps the range of others without hybridizing is the distinct species *lanceolatus*. Wallace (*op. cit.*, p. 23) thought that because *Garrulus* occurs from the British Isles to Japan and Formosa and yet is absent from many apparently suitable districts and is nowhere abundant, it is a "decaying" genus. This accords with the belief that the jays are in general a primitive group in process of displacement by more specialized corvids, but I am by no means sure that the facts mentioned by Wallace are reliable indications that *Garrulus* is a decadent genus.

THE AMERICAN JAYS

The approximately 32 species of American jays are, with the possible exception of *Gymnorhinus*, a closely related monophyletic group. The facts would be better expressed by placing them all in one genus than by splitting them into nine as was done by Ridgway (1904). An intermediate course is here followed, and four genera are recognized. These I believe are natural and monophyletic, but their characters are very trivial, intergrading, and variable, and later opinion may dictate further reduction. The assemblage may, by relying on a combination of characters, be split into two large genera, *Cyanocitta* and *Cyanocorax*, the latter slightly more specialized. Two additional genera, *Psilorhinus* and *Calocitta*, containing but a species or two each, must then also be upheld to retain a semblance of consistency in evaluating the characters of the group.

CYANOCITTA STRICKLAND (CRISTATA)

BLUE JAY, ETC.

SYNONYMS: *Aphelocoma* Cabanis (*californica*, a race of *coerulescens*); *Cissolopha* Bonaparte (*san-blasiana*); *Cyanolyca* Cabanis (*armillatus*, a race of *viridi-cyana*); *Garrulina* Gray (*unicolor*); *Lophocorax* Kaup (*diademata*, a race of *stelleri*); *Sieberocitta* Coues (*arizonae*, a race of *sordida*).

SPECIES: 1, *cristata;* 2, *stelleri;* 3, *coerulescens;* 4, *sordida;* 5, *unicolor;* 6, *pumilio;* 7, *nana* (not seen); 8, *mirabilis* (not seen); 9, *argentigula;* 10, *viridi-cyana;* 11, *turcosa;* 12, *pulchra;* 13, *melanocyanea;* 14, *yucatanica;* 15, *sanblasiana;* 16, *beecheii.*

RANGE: Alaska and southeastern Canada to western South America as far as Peru and Bolivia.

DIAGNOSIS: As compared with *Garrulus*, *Cyanocitta* differs as follows: no reddish or vinaceous in plumage; instead prevailingly blue or blue and black; usually without black bars on remiges and rectrices, when present they do not occur on the alula as in *Garrulus;* mandible less upturned, or not at all so; size usually smaller, body slenderer. *Cyanocitta* is much more closely related to the other American jays than to *Garrulus*, but is in general less specialized (see below).

The genus *Cyanocitta*, as thus delimited, contains the following sections:

1. *Cyanocitta* in the restricted sense contains two species, *cristata* of eastern, and *stelleri* of western North America. Unlike other members of the genus, they have occipital crests and black bars on the wings and tail. It is perhaps justifiable to consider the two as forming a superspecies, but *cristata* is somewhat more specialized than *stelleri* in color pattern.

2. "*Aphelocoma*," which contains the single species *coerulescens* (unless *californica* and *insularis* are considered specifically distinct), lacks the crest and black wing and tail bars of the preceding group. The wing is relatively shorter. It occurs in Florida, the southwestern United States, and Mexico.

3. "*Sieberocitta*" (including "*Garrulina*") includes two species, *sordida* and *unicolor*, which are usually referred to "*Aphelocoma*." They have a relatively longer wing than *coerulescens* or even *cristata*. *C. sordida* is more gregarious than *coerulescens*, has a finch-like note, and lays unspotted blue eggs. Less is known of *unicolor*, but unlike either of the other species mentioned it occurs in cloud forests, not semiarid regions. In proportions it is similar to *sordida*. This group ranges from Arizona to Central America.

4. The "*Cyanolyca*" group contains species 6–12, which occur from southern Mexico to western South America as far as Peru and Bolivia. They are much like the preceding two sections but have the black

eye stripe expanded into a mask. Often there is a light area on the nape and a crescentic mark across the breast like that of *C. cristata.* The frontal feathers are usually bristly or velvety.

5. *"Cissolopha"* contains the four species 13–16, which are closely related and evidently comprise a single superspecies. They have a heavier and more magpie-like bill, and the entire head and at least the anterior half of the underside are black. The group occurs from northern Mexico to Central America.

It is significant that four of the five groups are represented in Central America by forms that are primitive and similar to one another. These are *stelleri* (southern races), *unicolor*, *pumilio* (and *nana*), and *melanocyanea.* Furthermore, *"Cissolopha" pulchra*, which also occurs in Central America, is a link between *"Cyanolyca"* and *"Cissolopha."* It has the pattern of the former, but the heavy bill and to some extent the blackish head region of the latter. *C. pumilio* and *nana* similarly connect the *"Aphelocoma"-"Sieberocitta"* groups with *"Cyanolyca."* As Ridgway (1904, p. 324) pointed out they are structurally the same, while the color difference is much less than would be inferred from Ridgway's remarks. In fact Salvin and Godman (1879–1904, pp. 407–414) placed *nana* in *"Aphelocoma"* and considered *"Cissolopha"* a synonym of *"Cyanolyca." C. cristata* and *stelleri* are essentially similar to *"Aphelocoma"* in habits, and they should not be separated generically on such an extremely trivial basis as the presence or absence of a crest. The similar variation in the crest in *"Cissolopha"* among forms which Hellmayr (1934, p. 37) has even suggested may be subspecies (though I do not agree) was noticed above.

To summarize, although it is possible to subdivide the enlarged genus *Cyanocitta* into five sections, most of these contain but a single species or superspecies, and all of them are characterized by extremely variable and intergrading characters. All twelve of the species are similar in most respects, so it seems preferable to unite them in one genus.

GYMNORHINUS WIED (CYANOCEPHALUS)

PIÑON JAY

Brodkorb (1936, p. 1) is evidently correct in stating that *Gymnorhinus* Wied is not a homonym of *Gymnorhina* Gray and hence must be used for the piñon jay rather than *Cyanocephalus* Bonaparte.

SPECIES: 1, *cyanocephalus.*

RANGE: Southwestern United States and northern Lower California.

DIAGNOSIS: As compared with *Cyanocitta:* color nearly the same as in *C. sordida;* tail shorter; wing more pointed; flight stronger; bill longer and almost straight, slightly depressed towards its tip; nasal bristles lacking.

REMARKS: Though much like *C. sordida, Gymnorhinus* resembles *Nucifraga* also, as regards bill shape and proportions (although the tail is not quite so short). It has generally been placed with the crows and nutcrackers, not with the jays. I am inclined to consider the piñon jay a specialized American jay which parallels *Nucifraga columbiana* somewhat because of similarity in feeding habits. Both species feed on piñon cones, and I have seen them feeding together in the same woods in large numbers. A jay thus specialized for feeding on the cones of a tree which fruits irregularly and is discontinuous in distribution would require strong flight. The difference in relative wing length between *Cyanocitta coerulescens* and *sordida* is as great as that in tail length between the latter and *Gymnorhinus.* The absence of rictal bristles in the piñon jay is not surprising if it is an American jay, in which they are absent in some other genera, but is remarkable if it is a relative of the boreal nutcrackers. Nor is the blue color of *Gymnorhinus* suggestive of either species of *Nucifraga*, though it might, it is true, be a reversion to the coloration of the Old World jays ancestral to *Nucifraga.* The fact that the latter has its most specialized representative in the Old World suggests that it, like all the other more specialized corvine genera, is of Old World origin. There is a slight possibility, however, that *Nucifraga* is of New World origin and that *Gymnorhinus* is a true link between it and the more primitive *Cyanocitta*.

As regards habits, *Cyanocephalus* does not share the very early nesting season of *Nucifraga*, though the eggs of the two are rather similar. However, egg color varies greatly in *Cyanocitta*. Some jays of the genus *Cyanocorax* lay eggs similar to those of *Nucifraga*. The shrill flock note of the piñon jay suggests that of the Arizona jay, but certain notes of the former have been likened to those of crows or nutcrackers.

Comparison of a skull of *Gymnorhinus* with those of *Nucifraga*, *Garrulus*, *Cyanocitta*, and *Corvus* reveals that *Gymnorhinus* shares with *Nucifraga* a narrowing of the anterior part of the skull, correlated with the chisel-shaped bill. This is probably entirely adaptive. *Gymnorhinus* agrees with *Cyanocitta* and *Garrulus* in having the post-frontal and the squamosal process less prominent than in *Nucifraga* or *Corvus*, but this may be correlated with their smaller size. The skulls of all these species are very similar. Shufeldt's (1888) study of the skeletons of American Corvidae unfortunately did not include *Nucifraga*. Though he states in his conclusions that osteologically *Gymnorhinus* is a link between *Cyanocitta* and *Corvus*, in the actual comparisons of skeletal elements, wherever a difference exists between the two, he found *Gymnorhinus* to agree with *Cyanocitta* (pp. 330, 333, 341, 343).

While I believe that a preponderance of evidence indicates relationship of *Gymnorhinus* to *Cyanocitta* rather than to *Nucifraga*, it must be remembered that *Nucifraga* itself is only a specialized offshoot of the (Old World) jays.

PSILORHINUS RÜPPELL (MEXICANUS)
BROWN JAYS

SPECIES: 1, *mexicanus;* 2, *morio*. The two species occur together and are very similar. They may prove to be representatives of a single species, but this is unlikely (cf. Wetmore, 1943, p. 297).

DIAGNOSIS: Similar to the larger, coarser species of *Cyanocitta* ("*Cissolopha*" group) but structurally coarser; nasal bristles sparse; plumage dull brownish or dirty white. *Psilorhinus* has a crop-like furcular sac formed by a diverticulum of the clavicular air sac and used in producing a snapping sound (Sutton and Gilbert, 1942, p. 165).

REMARKS: *Psilorhinus* seems to be secondarily coarsened in structure and simplified in coloration until it is difficult to tell if it is more nearly related to the larger species of *Cyanocitta* such as *beecheii* or to *Cyanocorax* (as Salvin and Godman thought). Accordingly it is here placed between them, as the only logical alternative would be to unite the three genera. The furcular sac may be the best generic character of *Psilorhinus* as Sutton and Gilbert (*tom. cit.*) intimate.

CYANOCORAX BOIE (CHRYSOPS)
GREEN JAY, ETC.

SYNONYMS: *Coronideus* Cabanis (*violaceus*); *Uroleuca* Bonaparte (*cristatella*); *Xanthoura* Bonaparte (*yncas*).

SPECIES: 1, *caeruleus;* 2, *cyanomelas;* 3, *violaceus;* 4, *cristatella;* 5, *heilprini;* 6, *cayanus;* 7, *affinis;* 8, *cyanopogon;* 9, *chrysops;* 10, *mystacalis;* 11, *dickeyi;* 12, *yncas*.

RANGE: Southern Texas to Argentina.

DIAGNOSIS: Like *Cyanocitta* but in general more specialized; crest usually present but extremely variable; throat, breast, and usually large areas on sides and top of head black; the black breast more sharply demarked from the remainder of the underside than in any species of *Cyanocitta;* lower breast and abdomen and large areas in the tail characteristically white or yellow but sometimes blue or purple; size averaging larger and body form, legs, and feet more robust than in *Cyanocitta*.

REMARKS: *Cyanocorax* can be subdivided into the following sections:

A. The "*Coronideus*" group contains species 1–3, which occur in eastern South America. They are characterized by robust form and by a simple color pattern in which the abdomen and tail lack white and the head is entirely black. This group, although most like the more primitive *Cyanocitta* in coloration, is atypical by reason of its robust form, and in view of its distribution may be a side branch of the genus. "*Coronideus*" has not usually been recognized.

B. "*Uroleuca*" is usually treated as a monotypic genus characterized by the recurved crest of the single species *cristatella*. This species combines the robust form and black head of the "*Coronideus*" group with the white abdomen and white-tipped rectrices of the restricted *Cyanocorax* section. It occurs on the Brazilian tableland, suggesting relationship with the "*Coronideus*" group.

C. The restricted *Cyanocorax* section contains species 6–11, which occur in southern Sinaloa and from Central America to western South America as far as Peru. In this group the body is slenderer and the tail relatively longer; the abdomen and end of the tail are white or yellowish, and there is a characteristic head pattern of blue or white marks above and below the eyes, the lower one extending over the malar region. The rare *C. heilprini* of the Brazil-Venezuela borderland is so nearly intermediate between this and the "*Coronideus*" group that it cannot be included in either. It has the purple under parts of the "*Coronideus*" section, but the abdomen is whitish posteriorly, and there are narrow white tips on the rectrices; the head pattern is only partly developed, and the form is slender.

D. "*Xanthoura*" is another monotypic group; the sole species, *yncas*, ranges from southern Texas to Peru. It is even more slender in appearance, perhaps because its tail is relatively longer (see table 1 for proportions of this and other species of the genus). The under parts and lateral rectrices of *yncas* are bright yellow; the upper parts and central rectrices are green, washed with blue in some races; the frontal crest, as well as the usual marks on the face, is blue; the size is small.

The commonest type of crest in *Cyanocorax* is composed of bristly, narrow feathers, which are short in *cyanomelas* but longer in *heilprini* and others. In some species such as *yncas* the crest is essentially similar but the feathers somewhat softer. In *cristatella* the feathers of the crest are much longer and curved back over the crown. *C. cyanopogon* has a frontal crest of the usual type, and in addition the occipital feathers are lengthened and broadened to form a short, full crest which overhangs the white nape. As an example of the frequent parallelism which suggests that all genera of the Corvinae are rather closely allied, it may be mentioned that the Malaysian magpie, *Platysmurus*, has two similar crests. The type species *chrysops* is unique in that the feathers of the entire top of the head are bristly or velvety and not merely the frontal feathers. In *dickeyi* the crest is said to include the crown but not the occiput as in *chrysops*. Moore (1935, p. 275, pl.) described the crest of *dickeyi* as a "straight, stiff and erect crest, which tends to segregate at the apex into numerous tufts of stiff, narrow and unusually elongated feathers. . . ." In *chrysops* the form of the crest varies considerably among the subspecies.

Cyanocorax dickeyi, which I know only from the published plate and photographs, is a member of the restricted *Cyanocorax* group. It resembles *mystacalis* of Ecuador by having the head pattern white, the back blue (though not of exactly the same shade), and the tail extensively white. In *dickeyi*, however, even the lateral rectrices have dark bases, while in *mystacalis* they are entirely white. Presumably one must admit *dickeyi* to be closer to *mystacalis* than to any other species of the genus despite the more than 3000 miles which separate their ranges. Captain Delacour tells me he would consider them representatives of a single species or superspecies, but, aside from the geographical improbability of this, the striking differences in general size and in the crest are almost certainly of specific importance. I think it is possible that, in this assemblage of closely related species in which a few common characters occur in different combinations, this may be another instance of parallelism. At any rate, it seems misleading when Moore (1935, p. 277) states that *dickeyi* is furthest in characters from the geographically nearest species, *affinis*, which ranges north to Costa Rica. *C. dickeyi* may be as nearly related to *affinis* as to any other living species except (probably) *mystacalis*, and is, in my opinion, closer to *affinis* than to *heilprini* or *violaceous*, species which Moore mentions as resembling *dickeyi* in some respects. He might also have pointed out when emphasizing the territorial gap between *dickeyi* in Sinaloa and its congeners in Central and South America that the intervening area is occupied by "*Xanthoura*," which is obviously a *Cyanocorax* in essential characters, and by *Calocitta* and *Psilorhinus*, both of which are apparently offshoots of *Cyanocorax*. The American jays are concentrated in Middle America. Presumably competition is thereby increased, and it is possible that the small, isolated range of *dickeyi* is somehow correlated with this fact.

From the above discussion it will be apparent that *Cyanocorax*, as here understood, can be subdivided only by resorting to extremely variable characters. "*Coronideus*" with its simple coloration and robust form is perfectly united with the more typical members of the genus by *cristatella* and *heilprini*. The crest is so extremely variable in this group that it is inconsistent to maintain "*Uroleuca*" on this basis. Nor does the green back, yellow abdomen (the latter shared by the type species, *chrysops*), and long tail of *yncas* conceal the fact that it is a close ally of *chrysops*. The problem for one who would like generic characters to be more stable and substantial than specific characters is not whether to unite the above species in *Cyanocorax*, but how to keep *Cyanocorax* separate from *Psilorhinus*, *Calocitta* and, for that matter, *Cyanocitta*.

CALOCITTA GRAY (FORMOSA)
MAGPIE-JAYS

SPECIES: 1, *formosa*. The form *colliei* is considered specifically distinct by some authors.

RANGE: Mexico and Central America.

DIAGNOSIS: Essentially like *Cyanocorax*, but tail very long and graduated; some of the crown feathers much elongated and somewhat spatulate, forming a conspicuous crest; size large.

REMARKS: In view of the great variability in proportions and crests existing in the genus *Cyanocorax*, it is doubtful whether *Calocitta* should be kept separate. In *Calocitta f. colliei* we find the following unmistakable signs of close affinity with *Cyanocorax:* black throat and breast; white abdomen; similar head pattern and white in the lateral rectrices. In *C. f. formosa* the black throat and breast are absent except for a black bib similar to, and homologous with, that of *Cyanocitta cristata* and some other species of *Cyanocitta*. As noted above in discussing *Cyanocorax*, *Calocitta* has perhaps replaced more primitive earlier Mexican species of the former.

THE TRUE MAGPIES

Although the New World jays have given rise to some magpie-like types, notably *Calocitta*, the intergradation with the jays is so complete that no line can be drawn. In the Old World magpies there is a more definite gap separating them from the jays. *Garrulus lidthi*, however, has acquired some magpie-like characters and is quite similar to *Kitta*, especially *Kitta ornata*.

KITTA TEMMINCK (CHINENSIS)
GREEN MAGPIES, ETC.

SYNONYMS: *Cissopica* Delacour (*whiteheadi*); *Urocissa* Cabanis (*erythrorhyncha*).

SPECIES: 1, *thalassina* (and geographical representatives); 2, *chinensis;* 3, *whiteheadi;* 4, *ornata;* 5, *flavirostris;* 6, *erythrorhyncha;* 7, *caerulea*.

RANGE: India and Ceylon to China and Formosa south through the Malay Peninsula and Greater Sunda Islands.

DIAGNOSIS: As compared with *Garrulus:* structure coarser; size usually larger; tail more graduated and usually longer; bill, legs, and feet heavier and red or yellow in color (legs blackish in *whiteheadi*); nostrils exposed; nasal bristles sparse or absent. Differs from other magpies by the coarser, heavier bill, by having the bill red, and in other respects noted later.

REMARKS: This genus divides naturally into four sections:

A. *Kitta* proper contains two species, *thalassina* and *chinensis*, distinguished by small size; greenish or yellowish coloration which fades rapidly after death; coronal feathers lengthened, forming a crest; a black eye stripe which extends back beneath the crest; eyelids wattled and brightly colored. These species occur in dense mountain jungle in southeastern Asia and adjacent islands. As Delacour (1929, p. 3) indicated in his key to this group there are two natural divisions: (1) those in which the tertials are white-tipped and have a subterminal black spot, and the tail is relatively longer (*chinensis*), and (2) those lacking the e characters (superspecies *thalassina*). Whether the forms of group (2), all of which are geographically representative, are considered subspecies, or, in the more differentiated forms, species, is a matter of opinion. The members of group (2) from south (Java) to north (Hainan) are: *thalassina*, *jefferyi*, *hypoleuca*, *chauleti*, *concolor*, *jini*, and *katsumatae*. Peters (1940, p. 203) has already pointed out that Chasen (1935, p. 310) was in error in considering *jefferyi* and *thalassina* races of *chinensis*.

B. *K. ornata* of Ceylon has the eyelids wattled like the preceding group to which it has usually been referred, but it is closer to the following group, "*Urocissa*," with which it has in common concolorous head and breast, longer tail and coloration which lacks the evanescent qualities of that of the *Kitta* group. *K. ornata* differs from both *Kitta* and "*Urocissa*" by having the head, breast, and remiges bright rufous.

C. "*Urocissa*" includes *flavirostris*, *erythrorhyncha*, and *caerulea*. This section differs from *ornata* by lacking the wattled eyelids; the tail is even longer and the head, breast, and remiges are black or blue. The first two species are similar; *caerulea* of Formosa is probably a representative of one of them, but it is difficult to say which. *K. caerulea* is much bluer than either of the mainland forms and has a heavier bill.

D. "*Cissopica*," which contains only *whiteheadi*, was characterized by Delacour (1927, p. 164) as follows: "Differs from *Urocissa* in having a much coarser and more powerful bill and legs and a shorter tail.... General plumage grey, black and pale yellow, never blue. I chose the name of this new genus to show the affinity of these birds to the *Cissa* [group A above] which they exactly resemble in their voices and actions." Captain Delacour informs me that he now considers it preferable to include *whiteheadi* in *Kitta*, though it forms a distinct subgroup. *K. whiteheadi* is coarsened and simplified in coloration just as is *Psilorhinus* in the New World. The black breast and lighter abdomen of the "*Urocissa*" group are suggested in *whiteheadi*, and it also agrees with this group in its large size and coarse structure. However, it resembles the restricted *Kitta* group in some details as well as in habits and may be a link between it and "*Urocissa*."

The enlarged genus *Kitta* contains a natural assemblage of only seven species. The immediate common ancestry of all these species is obscured if they are placed in three or four genera.

CYANOPICA BONAPARTE (CYANUS)
AZURE-WINGED MAGPIE

SPECIES: 1, *cyanus*.

RANGE: Iberian Peninsula and eastern temperate Asia north to Japan and Siberia. (For a map of this remarkable instance of discontinuous distribution see *Ibis*, 1928, vol. 25, opp. p. 532.)

DIAGNOSIS: Coloration blue and white and rectrices white-tipped as in some species of *Kitta;* bill black and shaped as in *Pica;* nasal bristles well developed as in *Pica;* form slenderer, size smaller, legs weaker, plumage silkier than in either *Kitta* or *Pica;* nest open as in *Kitta;* primarily arboreal. *Cyanopica* connects *Kitta* and *Pica* in some respects, but is too distinctive to be united with either.

PICA BRISSON (PICA)
COMMON MAGPIE

SPECIES: 1, *pica*.

The yellow-billed magpie, *nuttalli*, of California is considered by many distinct enough to warrant specific status in the same superspecies as *pica*. Some of the Old World races at times build their nests at considerable heights in tall trees as does *nuttalli*. Yellow-billed individuals have occurred as sports in some of the Old World races. Coues' (1894, p. 421) statement that *nuttalli* is a "perpetuated accident" of *P.*

p. hudsonica is in keeping with present opinion as to the frequent fixation of non-adaptive characters in isolated populations.

RANGE: Palaearctic region and western North America.

DIAGNOSIS: Outer primary falcate; a distinctive color pattern of white and metallic bluish or greenish black; throat feathers lanceolate; nest domed, often with two entrances, with an interior cup of mud; feeds much on the ground, where it progresses mostly by walking. *Pica* is nearest to *Cyanopica* with which it shares characters mentioned in diagnosing that genus and also some details of coloration. It is less closely related to *Crypsirina* (including "*Dendrocitta*"). *Pica* is obviously an Old World genus that has reached North America relatively recently. Probably it will eventually adjust itself to conditions in eastern North America, since in the Old World it occurs both in semiarid and in humid regions.

CRYPSIRINA VIEILLOT (TEMIA)

RACQUET-TAILED AND TREE MAGPIES

SYNONYMS: *Dendrocitta* Gould (*leucogaster*); *Temnura* Temminck (*temnura*); *Vagabunda* Kaup (*vagabunda*).

SPECIES: 1, *vagabunda;* 2, *frontalis;* 3, *leucogaster;* 4, *occipitalis;* 5, *formosae;* 6, *bayleyi;* 7, *temia;* 8, *cucullata;* 9, *temnura.*

RANGE: India, southern China, and Formosa south through the Greater Sunda Islands to Bali.

DIAGNOSIS: Bill black, short, heavy, strongly arched, nasal bristles short but dense; color variegated brown, white, gray, or black but not blue, sometimes wholly black; frontal feathers short and velvety, especially in *temia* and *cucullata;* legs black and relatively smaller than in *Kitta* or *Pica;* proportions about as in *Pica;* nest open; primarily arboreal, hopping when on the ground.

REMARKS: This genus has the following three easily separated sections:

A. "*Dendrocitta*" contains species 1–6. Its characters are as for the genus; the rectrices are normal.

B. *Crypsirina* proper contains *temia* and *cucullata* characterized by smaller size; spatulate central rectrices; velvety frontal plumes and silky plumage. *C. cucullata* has a pattern much like members of the preceding group, but *temia* is entirely black.

C. "*Temnura*" contains only *temnura*, which has a restricted range in part of Indo-China. This species has rectrices that are incised along their edges and truncated at their tips as though bites had been taken from them. *C. temnura* is entirely black like *temia*, but the plumage is not so soft.

In various species of "*Dendrocitta*" the rectrices increase in width distally, thus foreshadowing the spatulate condition. This is especially true of *bayleyi* of the Andaman Islands, a species whose small size also suggests *temia* and *cucullata.* The increase in width of the central tail feathers distally in *bayleyi* is as follows in four specimens:

Width of feather near center: 19, 20, 20, 22 mm.
Width of feather near tip (specimens in same order): 23, 29, 29, 26 mm.

In *temia* the spatulate rectrices measure about 17 mm. across at the center and 39 mm. at the tip. The difference in feather shape involved is only a matter of degree and, other things being equal, would be of no more than subspecific value. *C. temia* is also specialized slightly by reason of its small size, silky black plumage, and especially the velvety frontal feathers which cover the nostrils and take the place of nasal bristles. However, *cucullata,* which agrees with *temia* in size, presence of spatulate rectrices, and has always been placed in the same genus, is intermediate as regards coloration and nasal bristles between the restricted *Crypsirina* and "*Dendrocitta*" groups. In view of the close relationship and minor distinctions of these two groups, it seems that the facts will be best expressed by considering *Dendrocitta* a synonym of *Crypsirina.* It is unfortunate that the latter name has priority over the better-known *Dendrocitta.* But for this, the two would probably have been united before now.

The little-known species *temnura* is a member of the *Crypsirina* group in the broad sense. The tail is variable in this genus, so it seems justifiable to include

"Temnura" in *Crypsirina.* Moreover, *temnura* links *Crypsirina* and *"Dendrocitta"* in some respects, just as *bayleyi* does in others. *C. temnura* has the black coloration of *temia*, but the coarser plumage and nasal bristles of *"Dendrocitta."* Its size is intermediate as shown by the following sample wing lengths of the species most important in defining the limits of *Crypsirina: temia,* 118; *bayleyi,* 121; *temnura,* 137; *leucogaster,* 148 mm.

PLATYSMURUS REICHENBACH (LEUCOPTERUS)

WHITE-WINGED MAGPIE

SPECIES: 1, *leucopterus.*

RANGE: Malay Peninsula, Sumatra, Borneo.

DIAGNOSIS: Differs from *Crypsirina* thus: frontal feathers bristly and elongated, forming an erect crest; feathers of occiput elongated and broadened, forming a short, full crest distinct from the frontal one; rictal bristles long; rectrices not spatulate; tail relatively shorter and less graduated; form more robust; plumage black with the exception of a white streak on the wing.

Platysmurus is a close ally of *Crypsirina* as shown by the similarity in bill form and other details. It resembles *C. temnura* especially. Presumably the long rictal bristles of *Platysmurus,* like those of its Malaysian associate *Platylophus,* are correlated with its jungle habitat.

With the genus *Platysmurus* we conclude the treatment of the true magpies.

PTILOSTOMUS SWAINSON (AFER)

PIAPIAC

SPECIES: 1, *afer.*

RANGE: Northern Africa south of the Palaearctic fringe.

DIAGNOSIS: Rectrices pointed, only ten present; form magpie-like; legs and feet very large; nasal bristles dense and short, meeting above the culmen; bill stout and arched; plumage black; lacrimals absent; vomer tending to be pointed anteriorly rather than truncate as in other Corvinae.

REMARKS: This is an aberrant genus whose allocation to the Corvinae has been questioned. It possesses the external characteristics of this family, such as nasal bristles, large, strongly scutellated legs, large tenth primary, and others, and I see little reason to doubt that it is an aberrant member of the group. Jackson (1938, p. 1268) wrote that *Ptilostomus* is a gregarious, noisy bird whose notes are a "shrill and squeaky pipe" and a chattering. It feeds on palms and also on the ground where it often attends livestock. Around camp it is very tame, and Jackson thought it would make a good pet; its nidification is crow-like. These habits suggest a corvine bird. Lowe (1938, p. 261) called attention to the skull characters mentioned in the above diagnosis. I have compared the skull with that of various genera of Corvinae, and in most respects they are similar. The loss of the lacrimals and the slight distinction in the shape of the vomer, like the reduction in the number of rectrices, attest that this is an aberrant genus, but do not, in my opinion, bar inclusion in the Corvinae. Lacrimals may also be wanting in *Podoces* which is certainly a member of the Corvinae, as Lowe (*loc. cit.*) could find none in two examined specimens.

I have placed *Ptilostomus* near the end of the magpies, but its very strong legs and black coloration suggest it may be an early offshoot of the *Corvus* group. The latter has had a long history in the Ethiopian region, as witnessed by the presence there of such distinct endemic species as *C. crassirostris,* while the magpies are not represented in the Ethiopian region unless by *Ptilostomus.*

PODOCES FISCHER (PANDERI)

GROUND OR RUNNING JAYS

SYNONYMS: *Eupodoces* Sarudny and Loudon (*biddulphi*); *Pseudopodoces* Sarudny and Loudon (*humilis*).

SPECIES: 1, *hendersoni;* 2, *biddulphi;* 3, *pleskei;* 4, *panderi;* 5, *humilis.*

RANGE: High, semiarid plateaus of central Asia.

DIAGNOSIS: Derivatives of Old World jays, but highly specialized. As compared with *Garrulus:* bill attenuated and decurved; wing and tail relatively shorter and legs longer; plumage sand-colored but with wings and tail mostly bluish black as in

Garrulus and sometimes with a dark malar area as in *Garrulus;* largely terrestrial and cursorial.

REMARKS: Hartert did not recognize either of the generic synonyms listed. "*Eupodoces*" *biddulphi*, as the generic name implies, is a true *Podoces* which resembles *panderi* so closely that it is unfortunate that a generic name was applied to it. "*Pseudopodoces*" *humilis* is much more distinct, but hardly enough so to require a monotypic genus. This little bird is not larger than a bluebird (*Sialia*). It has almost lost the darker markings, but the malar region and central pair of rectrices are dull blackish. As usual in genera whose species vary considerably in size, the tenth primary is relatively shorter than in the larger species of the genus. *P. humilis* nests in rodent burrows or crevices in walls. Its eggs have become white as in many cavity-nesting species. Some of the other species of *Podoces* exceptionally nest in subterranean holes, but usually build more or less jay-like nests in bushes and lay spotted eggs. *P. humilis* looks like a lark and represents the extreme of de-differentiation and loss of corvine characters.

NUCIFRAGA BRISSON (CARYOCATACTES)

NUTCRACKERS

SYNONYM: *Picicorvus* Bonaparte (*columbiana*).
SPECIES: 1, *columbiana;* 2, *caryocatactes.*

RANGE: Mountains of Eurasia and western North America.

DIAGNOSIS: As compared with *Podoces:* bill similarily long but stouter, less decurved, and with the mandible somewhat upturned; wings and tail mostly bluish black as in *Podoces* but with some white in tail; wing relatively much longer; legs shorter; body plumage ashy or brown speckled with white.

REMARKS: *Podoces* and *Nucifraga* both seem to be descendants of Old World jay stock but whether they resemble each other sufficiently to indicate a period of common ancestry after diverging from the jays, as suggested by Menzbier and others, is a moot question. *Garrulus*, *Podoces*, and *Nucifraga* are very distinct from one another.

The two species of *Nucifraga* are rather different; *caryocatactes* is a larger bird with much heavier bill, longer nasal bristles, and more uniform coloration than *columbiana*. Nevertheless, their similar habits and habitats and essential morphological similarity stamp them both as nutcrackers, and there is little reason to question the current practice of assigning both to *Nucifraga*. Stegmann (1934) gives reasons for considering *caryocatactes* more specialized than *columbiana* of North America; everything in their external appearance supports this conclusion. The common situation in which a primitive form survives in a peripheral area where it has escaped being overrun by successively more advanced types arising near the center of the origin of the group apparently exists in *Nucifraga*. It is, however, barely possible that the genus is of North American origin and related to *Gymnorhinus* as mentioned in discussing the latter genus.

PYRRHOCORAX TUNSTALL (PYRRHOCORAX)

CHOUGHS

SYNONYM: *Graculus* Koch (*graculus*).
SPECIES: 1, *graculus;* 2, *pyrrhocorax.*

RANGE: Palaearctic region in rocky or mountainous districts.

DIAGNOSIS: Plumage glossy black; nasal bristles dense; bill and feet yellow or red; tarsus booted; bill slender and decurved; wing long; tail short; flight powerful; habits terrestrial.

REMARKS: A very distinct genus. If *Corvus* is considered to be derived from *Nucifraga*-like stock, *Pyrrhocorax* in many respects forms a link between the two. If those who consider *Corvus* to be a relative of the magpies are correct, it is difficult to judge whether *Pyrrhocorax* is correctly placed near *Corvus* or near *Nucifraga.*

In 1760 an anonymous author published a perhaps rather fanciful account of a "little bird" supposed to inhabit the Islet de Met, near Rodriguez. It is commonly supposed that he was alluding to the extinct starling, *Necropsar leguati*, of which one specimen exists. Hachisuka (1937) somehow convinced himself that this description must refer to an extinct, turtleeating chough, and even went so far as to name this hallucination!

ZAVATTARIORNIS MOLTONI (STRESEMANNI)

Species: 1, *stresemanni* (described in 1938; no specimen seen).

Range: Southern Abyssinia.

Diagnosis: Circumorbital area and lores unfeathered; bare skin blue in life; coloration, shape of bill, and nasal bristles about as in *Nucifraga columbiana;* size scarcely larger than in *Cyanocitta cristata;* proportions about as in the American jay, *Cyanocitta sordida*, i.e., wing rather long, tail moderate; nest large, domed, with an entrance tunnel on top.

Remarks: Elsewhere (1943) I have summarized reasons for considering *Zavattariornis* a true member of the Corvinae. It is, however, so distinct that it is difficult to decide from published drawings, photograph, and descriptions to what living genus it is nearest in characters. Moltoni (1938) compared it with *Podoces.* The bluish black wings and tail of *Zavattariornis* suggest that it, like *Podoces* and *Nucifraga*, is a highly modified offshoot of *Garrulus*-like ancestry. The unfeathered, pigmented circumorbital area and domed nest, on the other hand, suggest the possibility that this genus, like *Ptilostomus*, may be an aberrant African representative of the magpies.

CORVUS LINNAEUS (CORAX)

CROWS, RAVENS, JACKDAWS

Synonyms: *Amblycorax* Bonaparte (*violaceus*, a race or geographical representative of *enca*); *Anomalocorax* Fitz (*splendens*); *Coleus* Kaup (*monedula*); *Corone* Kaup (*corone*); *Corvultur* Lesson (*albicollis*); *Frugilegus* Selys Longchamps (*frugilegus*); *Gymnocorvus* Lesson (*tristis*); *Heterocorax* Sharpe (*capensis*); *Microcorax* Sharpe (*jamaicensis*); *Macrocorax* Sharpe (*fuscicapillus*); *Nesocorax* Riley (*typicus*); *Physocorax* Bonaparte (*moneduloides*); *Pterocorax* Kaup (*albus*); *Rhinocorax* Sharpe (*rhipidurus*).

Species: 1, *tristis;* 2, *fuscicapillus;* 3, *validus;* 4, *unicolor;* 5, *typicus;* 6, *moneduloides;* 7, *woodfordi;* 8, *meeki;* 9, *kubaryi;* 10, *enca;* 11, *splendens;* 12, *frugilegus;* 13, *monedula;* 14, *brachyrhynchos;* 15, *leucognaphalus;* 16, *ossifragus;* 17, *jamaicensis;* 18, *caurinus;* 19, *hawaiiensis;* 20, *coronoides;* 21, *orru;* 22, *bennetti;* 23, *macrorhynchus;* 24, *corone;* 25, *torquatus;* 26, *corax;* 27, *cryptoleucus;* 28, *albus;* 29, *capensis;* 30, *rhipidurus;* 31, *albicollis;* 32, *crassirostris.*

Range: Almost cosmopolitan except in South America.

Diagnosis: Large, powerfully built birds; wing relatively long; tail relatively short; coloration mostly black, rarely grayish or brownish, not infrequently with some white areas in plumage; rictal bristles long; bill and feet usually large and strong.

Remarks: *Corvus* is the most advanced and successful genus of the Corvinae. Its large size and resilient, adaptable behavior have enabled it to exploit many secondary habitats produced by human activities. It has spread to many areas not otherwise inhabited by the group and as a result has split into almost three times as many species as any other genus of the subfamily.

Meinertzhagen (1926, pp. 57–58) has given reasons for combining all crows into one genus, though they were divided by Sharpe and others into about a dozen genera. The above arrangement is based partly on Meinertzhagen (1926) and I am also indebted to Dr. E. Mayr for assistance in the arrangement of this genus. In his opinion it is a mistake to combine the American crow (*brachyrhynchos*) specifically with *corone*, the two differing in voice and other respects. I have left the northwestern crow, *caurinus*, as a species, as it seems doubtful that it should be a race of the fish crow, *ossifragus*, of the east coast of North America.

Subgenera or other subgroups were not used by Meinertzhagen. Superficial similarity is so deceptive among the many species of this difficult genus, that the interrelationship of the species of the genus is a difficult task. A few natural subdivisions may be mentioned, however. Species 1–10 form a subgroup occupying southeastern Asia and the adjoining archipelagoes. *C. tristis* stands somewhat apart from the others by reason of partial loss of head feathers and dull coloration. *C. splendens* and *frugilegus* suggest one another in some respects, but this may be parallelism. The jackdaw, *C. monedula*, is rather distinct. In fact, Hartert left it in a monotypic genus, though most recent authors have lumped *Coleus* with *Corvus*. The jackdaw is small, has a characteristic small bill, nests in cavities, and lays eggs which are rather atypical in color for the genus. The American and Hawaiian crows, species 14–19, are probably allied, as are most of the following eight species, 20–27. The African crows, species 28–32, form a natural group, with the exception of *albus* which may be an African representative of one of the Asiatic groups and perhaps should come near *torquatus*. The three last species are in some respects the most modified of the genus. *C. rhipidurus* has a short tail. Its peculiar fan-shaped rictal bristles, as Meinertzhagen (1926, p. 96) pointed out, as well as several other characters show it to be a close relative of the large-billed *albicollis* and *crassirostris* and a link between them and other members of *Corvus*. Moreover, the bill is considerably smaller in *albicollis* than in *crassirostris* and scarcely bigger or more arched than in some of the Asiatic crows. The recognition of *"Corvultur"* seems unnecessary.

The relationship of *Corvus* to other genera is discussed below.

PHYLOGENY

The conclusions reached in the present study as to the interrelationships of the genera of Corvinae are represented in the accompanying diagram and summarized below. The jays are the most primitive subdivision. Most of the more specialized forms such as the magpies and nutcrackers seem to be variously modified jays. The jays are primitive not only morphologically but to some extent in habits, as indicated in the following quotation translated from the Heinroths (1924–1926, p. 235) based on study in the field and aviary of representatives of the genera *Garrulus*, *Nucifraga*, *Pica*, and *Corvus:* "We incline to the opinion that the jay [*Garrulus*] of all these genera has the Corvid characteristics least developed and in its behavior shows rather a certain similarity to bush-dwelling songbirds."

That the Corvinae evolved in the Old World is scarcely open to question. The groups to which they are most closely related occur exclusively in the Old World, chiefly in the tropics. Furthermore, all the more specialized genera of the Corvinae are primarily Old World, though a few of them, such as *Nucifraga*, *Pica*, and *Corvus*, have reached North America. This indicates a longer history for the subfamily in the Eastern Hemisphere, even admitting that the larger areas and perhaps more varied topography of the Old World might result in greater evolutionary advance. The primitive jay-group occurs both in the Old and New Worlds, but 32 of the approximately 38 species are American. This is evidently another instance of the type of distribution in which the primitive forms of a group have survived more abundantly in peripheral areas. In the Old World the jays have been almost eliminated by magpies, nutcrackers, and crows which are, after all, only transformed jays. In the New World there has been less competition, and the jays have undergone considerable adaptive radiation without losing their group characteristics. The very poor representation of the Corvinae in South America is another indication that the subfamily is of Old World origin.

Although the Corvinae are now well represented in both the Palaearctic and Oriental regions, the fact that closely related groups such as the birds of paradise are primarily tropical suggests that the group evolved in the Oriental region. Many forms occur in the Himalayan and Chinese mountains, which form the boundary between these regions, and it is quite possible that the Corvinae evolved in this general area and later spread both north and south. The jays, since they are the most conservative group in the subfamily, might be expected to furnish evidence on this point. *Garrulus* and *Cractes* occur chiefly in temperate or boreal districts, but the former extends south well into the Oriental region, while *Cractes internigrans* is endemic in the mountains of Szechwan, China. The resemblance of this species to *Garrulus lanceolatus* of the

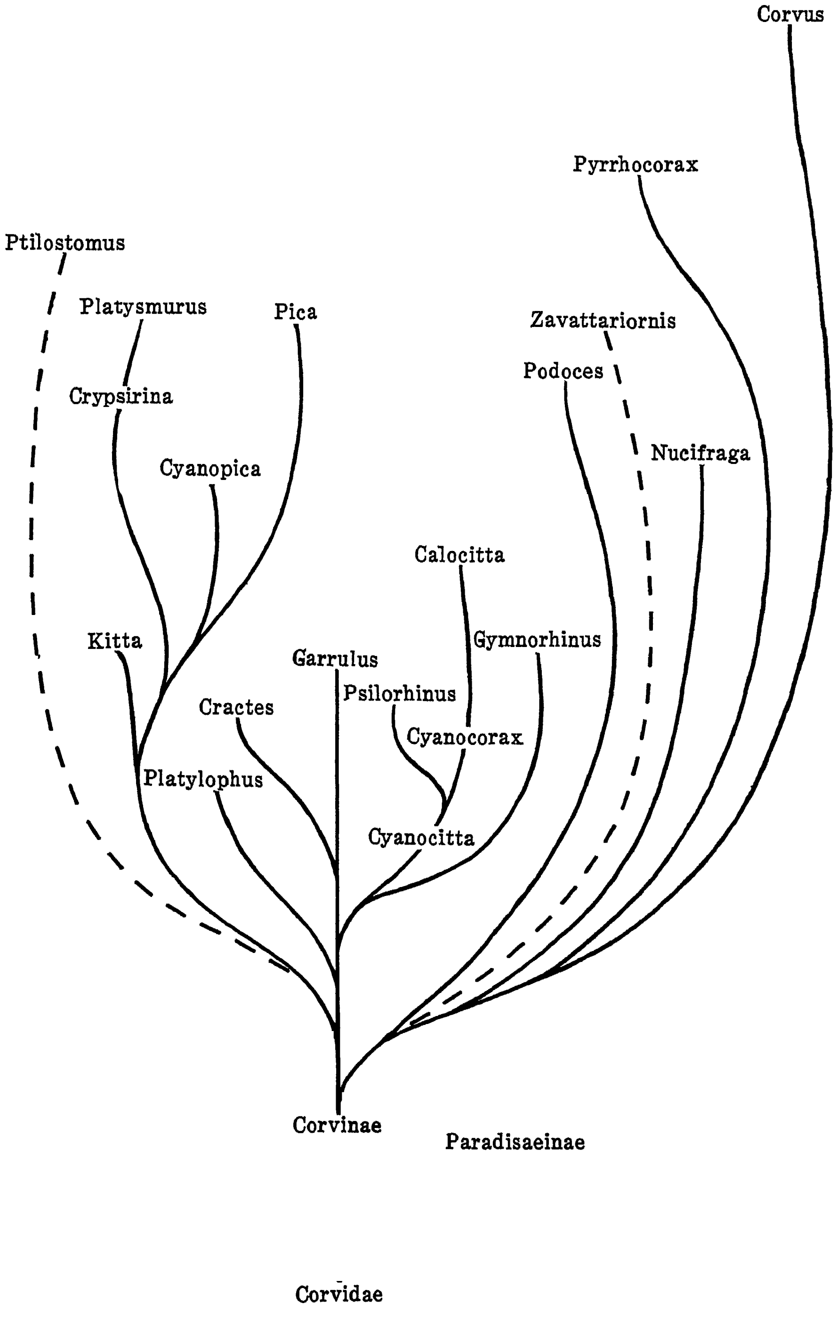

Fig. 1. Phylogeny of the Corvidae.

Himalayas is a point in favor of the suggested origin of the Corvinae in the mid-Asian mountains, since the Old World jays seem to have evolved there. *Platylophus*, the third genus of Old World jays, is entirely tropical but is aberrant and may not be a jay.

Since the Old World jays are few in number and may represent atypical forms which happen to have survived in the competition with magpies and other more advanced subgroups, the flourishing assemblage of American jays may be expected to give more reliable information as to whether the Corvinae evolved 'n a tropical or in a temperate region. The American jays are very predominantly tropical or subtropical. Of 32 species only six range as far north as the United States. Three of these are southern species which only cross the border into the southern United States. Another, *Cyanocitta stelleri*, ranges from Alaska to Central America; the fifth, *Gymnorhinus*, extends slightly into Mexico. Only *Cyanocitta cristata* is not found south of the United States, but it is a geographical representative of the *stelleri* group and occurs in the subtropical portions of southern Florida. On the basis of all the evidence, it seems probable that the Corvinae evolved in the tropics but that some members of the group early became adjusted to the colder climate of mountainous regions and were then able to colonize the Palaearctic and Nearctic regions.

The zoogeographical history of the jays is an interesting problem, though in the absence of fossil evidence conclusions must be very tentative. Since the New World jays are mostly tropical and the Old World jays probably were originally so, the entrance of jays into the Americas presumably occurred at a time when tropical faunas extended farther north than at present and were able to cross from Asia to North America via a Bering land bridge. The large number of tropical families common to the New and Old Worlds supplies conclusive evidence that such conditions once existed. As in most such families, the Old and New World species of jays have become generically distinct.

Since there are jays in the temperate regions, the possibility cannot be eliminated that in this case the intercontinental transit was made by a northern jay (just as *Cractes* has done more recently) which later entered the American tropics and gave rise to the genera existing there now. The genera of jays which now have a northern distribution (*Garrulus* and *Cractes* of the Old World and the *Cyanocitta cristata* superspecies in the New) do not link the jays of the two hemispheres and hence offer no support to this theory. *Cyanocitta*, as Ridgway (1904, p. 346) emphasized, is related to the tropical American jays, not to *Garrulus*. The former relationship is so close that various tropical groups such as "*Cyanolyca*," formerly considered genera, have been united with *Cyanocitta* in this paper. *C. stelleri* extends south in the mountains to Central America, suggesting that it represents tropical stock which first became adjusted to colder climates in the mountains and then ranged northward and spread over the North American continent. On the other hand it may have been a temperate-zone form which was forced south in the mountains by the Pleistocene glaciation and later returned northward.

It is significant that the American jays, though primarily tropical, are a distinctly North American group. South America has no endemic genera, though two of the North American genera, *Cyanocitta* and *Cyanocorax*, occur there. The considerable radiation of the American jays must have occurred in the tropics of North America before the re-establishment of the isthmial connection between the continents in the late Tertiary. The jays thus help to validate the belief recently expressed by Simpson (1943), following earlier work by Dunn, that the tropics of North and South America are more distinct faunally, as a result of the long period in which the two continents were unconnected by land, than is generally realized.

The magpies are an Old World group of genera which are essentially large, heavy-billed, long-tailed, short-winged, often brightly colored jays. They are birds of weak flight, adapted to forested or brushy country. The New World jays also include magpie-like types, notably *Psilorhinus* and *Calocitta*, but here the relationship is so close that generic division is difficult. In the Old World, on the other hand, two natural groups, jays and magpies, may be recognized with a perceptible but not large gap between them. The gap is most nearly bridged by *Garrulus lidthi* and *Kitta ornata*, though the resemblance of these two species is doubtless partly parallelism. Of the five genera of typical magpies, three, *Kitta*, *Crypsirina*, and *Platysmurus*, are Oriental in distribution. *Cyanopica* and *Pica* are primarily Palaearctic but extend into the northern parts of the Oriental region. They are offshoots of the more primitive tropical magpies.

In response to the peculiar conditions existing in the high, barren, or brushy plateaus of central Asia, the Old World jays have produced the peculiar genus *Podoces*. Its long legs, short wings and tail, decurved bill, sandy coloration, terrestrial, cursorial habits, and other distinctive characters make the gap between *Podoces* and *Garrulus* greater than that between *Garrulus* and the magpies. Nevertheless, *Podoces* has retained enough suggestion of the color pattern and other characteristics of jays to indicate beyond much question that it was derived from jays somewhat like the existing *Garrulus*.

Nucifraga, like *Podoces*, is a transformed Old World jay. It retains the bluish black wings and tail and a suggestion of the upturned bill of *Garrulus*. The tail is short, as in *Podoces*, but since *Nucifraga* is a bird of roving habits and inhabits mountainous country, its wings are long. *Podoces* and *Nucifraga* resemble each other in a few respects, and they may have had a period of common ancestry following their divergence from the jays. They are so distinct, however, that their few similarities may only reflect the fact that both were derived from the jays. The similarity in the nasal bristles is to be attributed to the cold climate of the regions inhabited by both genera. The possibility that *Nucifraga* is related to the American genus *Gymnorhinus* has been sufficiently considered in the remarks on that genus. *Nucifraga* reached North America long enough ago for the American species to become very distinct from the Palaearctic one.

The recently discovered Abyssinian genus *Zavattariornis* seems to resemble *Nucifraga columbiana* more than it does any other corvid; it has been compared also with *Podoces*. It is most surprising that a relative of either genus should exist in the brushy, hot country where *Zavattariornis* occurs. *Zavattariornis* has a bare pigmented area around the eye like *Pica*, and the nest is domed as in that genus. Possibly *Zavattariornis*, despite its short tail and long bill, is a magpie. The presence of a genus of the latter in Africa would be less remarkable in view of the occurrence there of *Ptilostomus* and of *Pica* in the Palaearctic fringe of northern Africa.

The choughs of the genus *Pyrrhocorax*, like *Nucifraga*, occur in the Palaearctic region and inhabit mountainous country. The two are similar in several details such as the nasal bristles, long bill, and proportions. It seems quite likely that *Pyrrhocorax* represents a further specialization of *Nucifraga*-like stock. *Pyrrhocorax* is very specialized by reason of its decurved, red bill, very long wings, booted tarsi, and black coloration.

Corvus has been considered to be related to *Pyrrhocorax;* the two are similar in proportions, color, and to some extent in habits. While this might be parallelism, it seems likely that *Corvus* evolves from the subgroup containing *Nucifraga* and *Pyrrhocorax*. The latter, despite its specializations, is intermediate between *Nucifraga* and *Corvus* in some respects.

Corvus also resembles the magpies. Shufeldt (1888) considered the skeletons of *Pica* and *Corvus* almost identical, except in size, and concluded that the two genera are closely related. The skeletons of all the Corvinae are much alike except in purely adaptive details. If *Corvus* evolved from the magpies, it must have branched off rather early in the history of that group to acquire such different proportions. The fact that *Corvus* resembles one of the most specialized of the magpies, *Pica*, much more than it does primitive magpies, such as *Kitta*, is strongly suggestive that this is a case of parallelism rather than of close relationship.

The rather generalized characters and almost cosmopolitan distribution of *Corvus* make it difficult to determine with finality to which other genera it is most nearly allied. If related to *Pyrrhocorax* and *Nucifraga* it is, one would suppose, of Palaearctic origin. Yet the presence in Africa of perhaps the most specialized species of *Corvus* suggests the possibility that this genus evolved in Africa following the colonization of that continent by some nutcracker-like or perhaps magpie-like species. If *Corvus* is of African origin, *Ptilostomus* may well be an isolated side branch of the same stock. In any event the large size and adaptable and aggressive nature of the species of *Corvus* have made it the most successful and widespread genus of the subfamily. The Palaearctic, Oriental, and Ethiopian regions contain many distinct species of the genus, but North America and Australia have been colonized more recently. The presence in New Zealand of remains of an extinct "crow," *Paleocorax*, would seem to indicate that the *Corvus* group reached the Australian region at a rather remote period, but it is by no means certain that *Paleocorax* is not a member of the Cracticinae.

Corvus has also reached the Philippines, Polynesia, the West Indies, and other areas not otherwise occupied by the Corvinae. Its superior colonizing ability probably derives from a combination of powerful flight and unusual ability to survive under new or unfavorable conditions.

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 50

A PRELIMINARY LIFE HISTORY STUDY OF THE FLORIDA JAY, *CYANOCITTA C. COERULESCENS*

By Dean Amadon

INTRODUCTION

The present paper is based on field work conducted at the Archbold Biological Station, Lake Placid, Florida, during the period from March 27 to April 29, 1943. This thousand-acre station is operated in cooperation with the American Museum of Natural History. Mr. Richard Archbold made constant efforts to facilitate my work while I was a guest at the station. For assistance in preparing the manuscript I wish to thank Drs. Robert Cushman Murphy and Ernst Mayr and Mr. Frank A. Pitelka. Dr. A. L. Rand gave me valuable suggestions during the course of the field work. References to time in this paper refer to War Time, one hour ahead of Standard Time.

As the study covered a period of only five weeks and some of my time was otherwise occupied, the results are preliminary. My experience with this species is limited to the period spent at the Archbold Station, with the exception of a brief observation of a few individuals of the Great Basin race, *woodhousei*, in Arizona in 1938. Despite these limitations, so little has been recorded on the behavior of the Florida jay, and that of an incidental nature, that publication of the present rather fragmentary findings seems justified. The western races of this species of the group *californica* have also been somewhat neglected. The appearance of Bent's volume on the Corvidae, now in press, may be expected to contain much information on the Florida jay.

In a paper on the genera of Corvidae (1944, Amer. Mus. Novitates, no. 1251) I have presented reasons for considering the genus *Aphelocoma*, to which the Florida jay is currently referred, a synonym of *Cyanocitta*. The jays are apparently more primitive than the other principal groups of the Corvidae such as the nutcrackers, choughs, crows, and magpies. The conclusion from morphology that jays are the most primitive of the Corvidae is corroborated by the following (translated) statement of the Heinroths (1924–1926, p. 235) based on study of the European genera in captivity and in the field, "We incline to the viewpoint that the Jay [*Garrulus*] has the Corvid characteristics the least pronounced of any native species and in its behavior shows rather a certain similarity to bush-inhabiting song birds."

Regarding the specific limits of *C. coerulescens*, I agree with Coues, Hellmayr, and others that the western forms generally grouped under the name *californica* are best considered races of *coerulescens* despite the hiatus in occurrence from Florida to western Texas. The distribution recalls that of the Old World *Cyanopica cyanus*, which occurs in the Iberian Peninsula and in eastern Asia, but not in the intervening area.

As in most species of Corvidae, males of the Florida jay differ from females only by averaging slightly brighter in coloration and larger in size. The latter difference is reflected in the various measurements as given by Ridgway (1904, p. 323) and also in the following weights secured during the present work, though unfortunately the sex of a majority of the birds weighed was unknown, male: 76.4, 80.2; female: 70.4; sex unknown: 83.7, 79.0, 72.7, 70.4

grams. These sexual differences are usually but not invariably sufficient to permit the male and female of a pair to be distinguished when seen together.

HABITAT AND GENERAL BEHAVIOR

The Florida jay requires open ground for most of its feeding and thickets of brush and small trees in which to perch, nest, preen, escape enemies, and do some feeding. As a result it is concentrated along the edge between brushy and open areas. At present it occurs mostly (at least in the vicinity of Lake Placid) along the edges of man-made clearings such as roads, fire lanes, and lawns. The scrub jay, as it is locally called, is limited to the type of vegetation known as Florida scrub. On the Archbold Station this jay is common, especially along the roads and about the dwellings.

The general appearance and dominant plant species of the Florida scrub are given by R. M. Harper (1927, pp. 79–81). Because of the variegated topography of Highlands County, much of the scrub in the vicinity of the Archbold Station is not typical but contains a great amount of dwarf wax myrtle (*Myrica pumila*) and scattered trees of the slash pine (*Pinus caribaea*) together with the usual undergrowth of saw palmetto (*Serenoa serrulata*). In some places more typical scrub containing much spruce pine (*Pinus clausa*) and scrub oaks (*Quercus* sp.) occurs, but the jays, at least during the period of observation, preferred areas dominated by myrtle.

The Florida jay has the usual inquisitive, meddling, raucous habits of most jays, and is as fearless as the Canada jay (*Cractes* = "*Perisoreus*"). As several authors have noted, the Florida jay, if given the slightest encouragement, will perch on the head or shoulders of a human and take food from the fingers. It enters traps fearlessly and repeatedly. An interesting geographical variation in disposition exists in the races of *coerulescens* which can hardly be other than genetic. The Californian races are said to be quite tame when not persecuted, but the race *woodhousei* of the Great Basin is more furtive. Most writers on Arizona birds from the time of Merriam to the present have referred to it as shy and suspicious (see, for example, Swarth, 1904, p. 29).

Although the Florida jay spends much time on the ground, it never walks but hops with its sturdy legs rather widely spaced. I saw one hop rather than fly across a 75-foot paved court, giving a flip of its wings with each hop. When observing a person, they often go to the ground and look up. They also hop a great deal in the branches of bushes and trees, and, more often than not, reach their favorite lookout posts in the tops of bushes by hopping up through the branches. The flight of the Florida jay could hardly be described as weak, although they were observed among the higher branches of the tall pines scattered around the station grounds much less frequently than the blue jay. Yet occasionally the Florida jay takes flights of several hundred yards. One male sometimes flew from his nest to a perch about 40 feet high in a pine 30 feet from the nest. This resulted in an almost vertical flight, and sometimes he would fly against the trunk of the tree about halfway up and give a thrust with his legs which aided the remainder of the flight. *Cyanocitta coerulescens* has a relatively short wing as compared with *C. cristata*, or *sordida* (includes *sieberi*); this is doubtless correlated with its weaker flight.

FEEDING HABITS

Like other corvids, the Florida jay holds large pieces of food in its feet while breaking them with its bill. It also buries or otherwise conceals surplus food. When I put an abandoned jay nest containing one addled egg in the cage with a pair of captive jays, the male went to the nest immediately, seized the egg, carried it to the corner of the cage, and pushed it beneath the sand. Then with quick nervous movements he placed seven dead myrtle leaves over it. When the leaves were removed, a small portion of the egg shell could be seen above the sand; the egg was unbroken. In this case the food was evidently buried to keep another jay from getting it. This seems to support Rand's (1937, p. 41) suggestion that this instinct is an expression of "greed" and not of foresight. When burying a piece of bread or an egg a jay holds the object in its bill and seeks to push it beneath the sand without digging a hole or looking for an existing one. This is an awkward and inefficient process and usually part of the food remains visible. This is customarily concealed by covering with any convenient small objects. A different method of burying was once seen. A jay drove a kernel of corn beneath the sand with blows of its bill similar to those used in breaking food and then placed a leaf over the spot. Perhaps this method is used in burying acorns and other hard objects. More probably the jay intended to break the kernel and eat it, and the burying reaction followed when the kernel disappeared in the sand.

Jays were frequently observed searching for buried food (acorns) in fire lanes or other sandy areas. The head is swung from side to side with the bill pointed in the direction of movement. Spurts of sand are thrown first to one side and then to the other. This method of digging suffices in the sandy habitat of this species but would be ''neck-breaking'' in firm soil. Dr. A. L. Rand suggested to me that the jays may dig wherever there is a leaf which might mark a cache. The one bird which I briefly observed after this possibility was realized did seem to favor such places, but this was inconclusive. (See Strauss, 1939a, and Rand, 1937, for experimental studies of food burying by Corvidae.) Jays were observed digging in a lane which had just been harrowed, thus obliterating all small marks. The jays were frequently seen to eat acorns; presumably these had been buried the preceding fall.

Florida jays require a solid object upon which to hold acorns while breaking them with the bill. Pieces of wood projecting a foot or less above the soil in an open place are preferred. I found the opened shells of over 125 of the small acorns of the scrub oak beside one such "anvil," in this case a projecting root. They often carry an acorn as much as 50 feet to a favorite perch. As frequently, the food is taken to any convenient branch in a nearby bush. Rather large objects may be swallowed without subdividing. I offered a large disabled horsefly, *Tabanus imitans*, at least an inch long to a captive male jay, which swallowed it entire.

Blows of the bill similar to those used in pulverizing food are used as a substitute activity (Rand, 1943, p. 170), chiefly when an intruder is at the nest. I held a shrike egg in my hand near a male captive jay. He was eager to have the egg, but did not dare come closer than 3 or 4 feet. In frustration, he yanked the leaves from a twig near his feet and dropped them one by one, then bit off the twig bit by bit and finally struck savagely at the branch upon which he was perched. Grimes (1940, pp. 435, 436) speaks of a male Florida jay almost pounding its nest to pieces when an intruder was near. His photograph illustrating this shows the bird with bill widely opened, but of course it is normally closed when striking an object. Similar behavior is known in the blue jay, magpie (*Pica*), and other corvids.

Such behavior as that just described is much more pronounced in the male, which in the Florida jay is more aggressive than the female. The male of my captive pair would dash after any morsel of food tossed into the pen, intimidating his female cagemate by screaming and aggressiveness. Once I tossed a desiccated spadefoot toad to the male to distract him and then gave an addled shrike egg to the female. She took the egg in her bill but then put it on the sand again as though uncertain what to do with it. The male dashed in screaming, seized the egg and ate it.

In the spring the Florida jays feed mostly upon animal matter; acorns were the only exception noted. Jays hop along looking for insects or other small animals and when necessary make spirited chases after them. Richardson's (1938) description of a California jay chasing house flies on a lawn applies well to the actions of the Florida subspecies when catching insects: "A jay would hop around with head held high until a suitable fly was seen. Then ensued a short dash, usually of two feet or less but sometimes as long as four, with the head held low and extended forward. This dash, which consisted of a series of quick hops, usually ended with a final long hop, the abrupt raising of the tail, and the coincident successful capture of the fly. As nearly as could be seen the flies usually were deftly snatched before they flew, but occasionally they were caught in the air." In the Florida jay such pursuits are often continued for 10 feet or more and the bird makes extremely abrupt turns, aided by the wings. Sometimes they pursue an insect into the air for 3 or 4 feet, often almost turning a loop while doing so. California jays have been observed to pursue and catch large scarab beetles (*Pleocoma behrensi*) in the air (von Bloeker, 1935), but purely aerial sallies for food were not noted in the Florida jay. The latter sometimes drops down from a favorite perch on a telephone pole or bush to seize an insect but does not habitually feed in this shrike-like manner. Once a jay fluttered to a post ahead of me with its bill full of grass, which it then held under its foot while extracting a moth therefrom.

Jays were observed pulling energetically on large insects or other small animals crushed in the road by cars. Usually they will allow even the noisiest truck to pass at a distance of 6 or 8 feet. As a rule they are too self-possessed to blunder in front of cars but we have a museum specimen killed in that manner. A jay which found a hairy caterpillar about $1^1/_2$ inches long took it to a bare sandy place and rubbed it vigorously back and forth in the sand for several seconds. He then fed it to his mate, who swallowed it after some hesitation. Another jay was seen to kill a small snake 3 or 4 inches long; the snake was tossed this way and that, then carried 30 feet, and the process repeated. Finally it was taken into some bushes, where presumably the coup de grâce was administered. Two or three minutes later this jay appeared in a pine tree in the top of which his mate was perched and hopped up through the branches. The female begged and reached down as he offered her the snake. One end of the snake must have been lodged in the male's throat, as the female was pulled bodily from her perch and after considerable fluttering settled on a twig beside the male below. During my absence two jays were observed by a group of workmen to attack a foot-long "blacksnake" crossing a pavement. The snake coiled and struck, but the other jay pecked at him from behind; more jays were attracted by the excitement, and the snake was overwhelmed and killed. A California jay has even been seen to seize a kitten of the domestic cat and carry it some distance, though not, it was thought, with the intention of eating it (Mailliard, 1904).

During the last days of April the myrtle (*Myrica* [*Carothamnus*] *cerifera*) and other bushes were in blossom, and many insects were attracted. The jays at this time did much of their feeding in the bushes, hopping slowly about among the terminal twigs. Once I noticed one swinging below a twig like a chickadee, while picking insects from the leaves. Although the Florida jay spends much of its time in the dense scrub, its ground feeding is done for the most part in open areas rather than beneath the bushes, probably the better to enable it to avoid predators.

Surface water is rather scarce in the sandy, bushy country frequented by the Florida jay, and possibly this species can do without it during the summer when insect food is plentiful. On the Archbold Station the jays have learned to drink from leaking faucets in the extensive sprinkling system. The faucets are about a foot from the ground; sometimes the jays jump into the air to snatch drops of water forming from the faucet. One jay stood with bill directed upwards and caught drops of water as they fell. One hot afternoon I saw seven jays disporting on a lawn in the mist from a sprinkler.

CALLS AND SONG

The usual call of the Florida jay is a harsh, grating *kă* repeated several times. This apparently corresponds to the familiar scream of the blue jay. It is given in a variety of situations: (1) when scolding; (2) perhaps to draw attention to itself (by birds that came to the vicinity of dwellings to be fed); or (3) merely to express excitement. When the jay is greatly excited, this note becomes more of a screech: *kē* or *kwē*. Birds in a trap sometimes gave this note as I approached, and sometimes it is directed at an intruder at the nest, rather than the more usual *kă*. Jays frequently screech (*kē*) every time they dash after a morsel of food thrown to them. At times notes similar to those described above but with an *r* sound are given; such calls are less harsh: *kra* or *krēr*. Such notes seem to be directed towards other members of the species rather than towards external objects, and are commonly uttered more rapidly. In the noisy squabbles which occur so frequently, a rapidly repeated *krē* or *kra* is the commonest note. This is evidently the note that other writers have called a *churr*. Sometimes between series of such notes a chirp is given, which reminded me a little of that of the robin (*Turdus migratorius*). A female jay which I removed from a pen at night after blinding her with a light, gave a loud "squalling" as she was carried, somewhat like the usual alarm notes, but with an element of terror added.

The Florida jay expresses alarm or excitement by bobbing its head and flitting its tail, as well as by alarm notes. Sometimes notes like those described above are given in a very subdued manner. When feeding or at the nest together, a pair of jays often converse in low notes which sound like *kă* or *kwa* or *kwe* and are audible for only 50 feet or so. Sometimes a jay which is curious or puzzled, e.g., by coming upon a quietly seated human, will give such low notes, followed perhaps by louder scolding notes. What appeared to be non-breeding birds will often give a querulous soft *kwē* when separated from their companions; under such circumstances they usually beg from any (male?) jay which happens to come near them. The calls thus far described are essentially variations of a single type of note.

A female which I lifted from her eggs, in order to mark her, gave a low note which I recorded as a *cluck* when released on the ground beneath her nest. The begging calls of young in the nest are of the chipping type common in many passerines. During courtship feeding the adult female gives begging notes that are similar to those of the young. The adult male was never heard to give such notes.

Like many other corvids, the Florida jay has a warbling song which seems always to be given in a whispered or subdued manner. Wetmore (*in* Howell, 1932, p. 339) described this song as, "a mixture of sweet low-toned calls, high in pitch, mingled with others that were variously slurred or trilled in utterance." To me this whisper song somewhat suggested the usual song of a catbird (*Dumetella*), but it is much softer. Leach (1927, p. 234) described the song of the California jay as "... some of the sweetest and softest warblings of bird music. It was never given in vibrant tones, but in low soft notes, scarcely audible beyond a hundred feet or less, as if the birds were indulging in private rehearsal." The whisper song has also been compared with that of a canary and a thrasher.

One afternoon a very tame jay appeared and perched on my arm and then on my head. Soon it hopped to a sunny perch in a nearby bush, fluffed its feathers, opened its bill as though yawning (Strauss, 1939a, p. 160, found that jackdaws, *Corvus monedula*, yawn), and then gave a whisper song. The European jay (*Garrulus*) is said to give its whisper song under such circumstances (Voigt, 1920, p. 149). On two other occasions, as I was quietly observing, a lone jay appeared and gave subdued alarm notes followed by a whisper song. Both the male and female of a caged pair sang from the back of a thick bush as I worked in the large cage. They were undoubtedly mildly alarmed by my presence. After bringing them to New York the male was once heard to sing briefly following alarm incidental to removing the other bird from her cage. The whisper song thus seems at times to express mild alarm or perplexity. At other times, as when given by a bird sunning itself, it might express physical well being. In any event the whisper song seems to have no relation to reproductive behavior. Some of the birds giving it were, I thought, first-year.

The most unusual sound produced by the Florida jay I called in the field the *klok* note, but following Sutton and Gilbert's (1942) description of what may be a corresponding performance in the Mexican brown jay, *Psilorhinus morio,* I am calling it the "hiccup." The hiccup of the Florida jay has a hollow mechanical sound, like rattling two sticks together, or like tapping on a heavy block of wood with a mallet. Once I momentarily mistook the tapping of a red-bellied woodpecker (*Centurus carolinus*) on the bottom of its nest cavity in a telephone pole for the hiccup of the jay. When heard at close range the hiccup has a double effect similar to that produced by snapping in and out the bottom of an oil can. The hiccup of the Florida jay is customarily given in an agitated manner. The bird directs its head and bill upwards, and a series of hiccups is then given as the head is thrust upwards in spasmodic, piston-like thrusts. The bill is opened each time the sound is emitted. The tail is slightly spread and, if the bird is perched on the ground, it is pressed against the ground as a result of the upward thrust of the head and neck. Usually about six to twelve hiccups are given in a series, sometimes so rapidly as to sound almost like a roll. I once saw a bird hiccup without thrusting the bill upwards, and the notes were then given at irregular intervals. This was unusual, although the degree of physical agitation accompanying this curious act varies.

In the brown jay, as described by Sutton and Gilbert, the hiccuping is produced by the inflation or deflation of a furcular pouch, which is a diverticulum of the clavicular air sac. In the Florida jay such a sac is evidently not present, as it has never been described and I have been unable to see any indications of one externally. Nevertheless, in view of my strong conviction in the field that the hiccuping of the Florida jay must somehow be produced mechanically rather than vocally, it seems likely that this sound is produced in a homologous manner in the two genera, although accompanied by little, if any, morphological modification in the more primitive Florida jay. Eventual anatomical examination of the birds now in captivity will settle this point. If the hiccuping does prove to be homologous in the two, it will then be quite certain that acquisition of this unusual method of producing sound preceded and presumably aided in the development of the furcular sac as it now exists in *Psilorhinus*.[1]

In the Florida jay the hiccup is given usually, and I believe exclusively, by the female. On all the many occasions when a bird whose sex was known hiccuped it was always a female. When a female was giving this sound, I have seen her mate thrust his bill upwards in excitement, but no audible sound resulted. The male did not thrust his bill upwards in the spasmodic manner of the female. The hiccup note was recorded in the Florida jay under the following circumstances: 1. In any situation involving sexual antagonism to jays other than her mate, the female hiccups. I twice saw the hiccup given in a very agitated manner by a female attacking a stuffed (male) jay. After a period of excitement a female would sometimes hiccup every time her mate flew. 2. In a pair engaged in what was apparently pre-nesting courtship the female hiccuped after the male had been away for several minutes and he returned and fed her. 3. From a female in an outside cage when another jay flew near the cage. 4. Once from a bird that came to the porch to be fed. 5. Once in a subdued manner from a lone bird that seemed to be curious about me.

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[1] Since the manuscript was completed, Dr. E. Mayr has kindly dissected a female Florida jay for me and we found no indication of a furcular pouch like that of *Psilorhinus*. I am still inclined to think that the hiccuping of the Florida jay is non-vocal, although it is uncertain how it is produced.

To summarize, in the nesting season, the hiccup of the female Florida jay is normally given as a threat to other Florida jays. When her mate is present it perhaps has the function of "backing him up" in a squabble; when he is absent it may serve to call him. It was heard on only two or three occasions (of 100 at least) when it seemed to be directed at objects other than members of the species, but even then the bird may have been calling her mate. When an intruder other than another Florida jay (such as a human or an owl) approaches a nest, vocal alarm notes are used, not the hiccup. A longer study extending through the non-breeding season will be required for a complete interpretation of the significance of this sound. In the brown jay the hiccup is said to be "a signal for quiet, for stealthy approach, for close attention to some not quite solved problem" (Sutton and Gilbert, 1942, p. 164). This suggests that its function in *Psilorhinus* is not the same as in the Florida jay.

NOTES ON COURTSHIP

The following observations were made on unmarked birds which may already have had nests. As with most corvids, courtship feeding of the female by the male is prominent. Only food which does not require further breaking with the bill seems to be offered in such feeding. Grimes (1940) has published a photograph of a male feeding a female on the nest.

On March 30 at 8:45 A.M. a (female) jay was observed to beg and be fed by a second bird, presumably her mate. This was repeated every three or four minutes. The male usually carried the food to the female as she perched on a fence post. Sometimes he brought food as far as 60 feet, even though the female was not begging. At times the female fed by herself on the ground. On one occasion, just after the female fluttered to the ground, the male began to hop around her in small circles with his head held high and his tail widely spread and dragging on the ground. The female obviously resented this courtship display and warded the male off by rotating her head so as always to direct her half-opened bill at him in a threatening manner. The male made at least ten circles around her.

A passing truck frightened the birds across the road behind a fence. I went over and found four or five jays. Two of them began to fight, but a third dashed in and interrupted them. After a few minutes the pair separated from the other jays and resumed courtship feeding. Later the female flew into some bushes and preened for ten minutes, during which time the male disappeared. Suddenly the female became alert and gave a low *kà* and then hiccuped. Her mate at once appeared from some bushes across the road and fed her. They fed along the road together and at 10:15 drank from a leaking faucet. It was now quite hot and they were less active. I left at 10:30, just after the male had fed his mate for the first time in 15 minutes. They had not moved more than 200 feet from the place where they were first observed, but on the following day could not be found in the vicinity.

On April 2 at 10:00 A.M. I briefly observed a male on a road displaying around a female in the manner described. A third jay seemed to resent the display and flew towards the pair. There was some excitement followed by a chase, and the intruder was driven off. The male then fed the female three or four times at short intervals. Once he carried a large object to a root and began to break it with his bill. The female fluttered down beside him begging loudly and was fed.

Swarth (1904, p. 30) observed a display of the related Arizona jay (*C. sordida arizonae*) before a rattlesnake which was much like the courtship display of the Florida jay: "Some of the boldest lit a short distance from the snake and strutted before it in a most curious fashion, head and body held bolt upright, and the tail pressed down on the ground until about a third of it was dragging. A bird we had in captivity for some time strutted about in the same comical fashion whenever it was angered and wished to show fight."

Mr. F. A. Pitelka has pointed out to me that this similarity in the anger display and snake display of *C. sordida* to the courtship display of *C. coerulescens* tends to confirm the view he has expressed in recent papers (1942, 1943) that so-called courtship displays of birds are basically intimidation displays.

On April 20 I saw a female jay on a telephone wire beg very loudly and actually flip her wings over her back, rather than merely flutter them. She dropped down beside a male in the nearby fire lane and he fed her several times. Once he hopped about a foot into the air, seized a black beetle from a blossom and took it to the female, who was not begging at the moment. She swallowed it after hesitation. The female crossed the road to drink and then both flew up the road, where there were other jays. After a few minutes, one (evidently the male) began to hop down the fire lane followed by the begging female. The male hopped very rapidly for at least 100 feet, using his wings somewhat as though to avoid the female. The female followed for the entire distance with wings flapping, and begging loudly. They perched in a bush where there was a third jay; the female begged querulously for a time and then preened. (See also notes given above on courtship feeding in discussion of feeding habits.)

Copulation was never observed.

REFERENCE LIST OF NESTS

Nest 1 was 4 feet high in a myrtle. It contained two eggs when found on March 27; this proved to be the complete clutch. On April 11 one egg was missing and the other pipped; it hatched the following day. This indicates an incubation period of at least 17 days. The young was in the nest on April 19, but the next morning the nest was empty.

Nest 2 was 5 feet high in a myrtle. It contained one egg on March 27 but was deserted because of tampering, as explained elsewhere.

Nest 3 was 9 feet high in a myrtle. It contained one egg on March 27; two more were laid. Incubation was in progress on April 6, but on the morning of the eighth the eggs were gone and the parents absent.

Nest 3A was a repeat nest of the preceding pair, at least the marked female was the same bird. The nest was 8 feet high in a myrtle and about 100 feet from nest 3. It is interesting that the two nests of this pair were the only ones of about a dozen examined (including old nests) which were over 5$^1/_2$ feet from the ground. Nest 3A was found April 10; probably it was begun the preceding day; the first egg was laid on April 16; the clutch was four; incubation was still in progress on April 29 when I left. The female of this pair was marked.

Nest 4 was 4 feet high in a dwarf holly. It was found on April 9 when the female was incubating three eggs. These must have been on the point of hatching, but it was mistakenly assumed that they were fresh, as a fruitless search for nests in this vicinity had been made in late March. On April 19 I was surprised to find young in the nest, larger than the young in nest 1 which hatched April 12. Probably the eggs in nest 4 hatched on April 9 or 10. The young were quite well feathered by April 29, but probably did not leave the nest for another week.

Nest 5 was 4 feet high in jessamine vines on a fence. It was found on April 21 when it contained three young about the size of that in nest 1 and one addled egg which was on the backs of the young. It was not visited after April 22. This nest and one old nest in rose vines were the only jay nests seen in the miles of vine-covered fences on the station.

Nest 6 was 4$^1/_2$ feet high in a myrtle. It was found on April 23, the day it was begun; it was finished on April 27. No eggs had been laid by the twenty-ninth. The male of this pair was marked.

In the text nest 1 is referred to as N1, the female of this pair as F1 and the male as M1, and the other nests are referred to in corresponding manner.

NEST-BUILDING PERIOD

The building of two nests, N6 and N3A, was observed, the former from the first and the latter from the second day of building, judging from their appearance when found. Data on attentive and inattentive periods and on the number of trips made are given in tables 1 and 2. Nest 6 was essentially completed on the morning of April 27, but no eggs had been laid by the afternoon of the twenty-ninth. It was unknown whether this was a first nesting for the season by this pair. Nest 3A was a re-nesting of the pair whose eggs disappeared from N3 a few days before. The marked female was the same. Since this second nest was started so promptly, it is probable that the male was the same bird also. The two nests were on opposite sides of the road and about 100 feet apart; material for the second nest was not taken from the first.

April	Period of observation	Attentive (building) and inattentive (not building) periods; latter in parentheses. Time in minutes		Total number visits to nest (♂ or ♀) for each attentive period or part thereof	Male fed female at
23	10:45–11:10 A.M.	25+	—	4+	—
"	1:25– 3:45 P.M.	56+(23)61+	[84%]	15+, 26+	—
24	8:55–11:07 A.M.	20+(35)77+	[73%]	11, 19	10:30
"	1:43– 2:00 P.M.	17+	—	(Disturbed)	—
"	2:30– 3:04 P.M.	34+	—	8	—
25	9:50 A.M.–12:20 P.M.	(40)30(19)61+	[61%]	2±, 6+	10:45; 11:05
"	3:15– 4:03 P.M.	48+	—	13	—
26	8:50–10:30 A.M.	(70+)31+	[31%]	5±	9:14; 10:28
"	3:30– 5:30 P.M.	(113)7+	[6%]	2±	3 times or more
27	9:00–11:00 A.M.	?*	—	6±	1 time
"	2:30– 3:00 P.M.	(30+)	—	—	1 time
"	7:30– 8:10 P.M.	(40+)	—	—	2 times

TABLE 1. Data on building of nest 6 which was begun on April 23 and almost completed by the twenty-sixth, although a little work was done on it on the twenty-seventh. For each period of observation of over 60 minutes, the percentage of time spent in nest building (attentive periods) is given. (See text.)

* Pair near nest throughout this period and made occasional visits to nest, once with material; exact time of these visits not recorded.

During inattentive periods the birds usually left the vicinity of the nest. In doubtful instances, only absences from the nest of both birds for 15 minutes or longer have been recorded as inattentive periods. When a period began before or finished after the particular period of observation, a plus sign is added in the tables. The only two complete (observed from beginning to end) periods of attentiveness (with the exception of a momentary visit to the nest during a long period of inattentiveness on April 12) were of 30 and 31 minutes' duration, respectively, but incomplete periods of as much as 158 minutes were recorded. Inattentive periods usually ranged from about 25 to 60 minutes, but one of 113 and another of over 70 minutes occurred.

The tabulated data give a general idea of the nest-building activities, but such rhythms are extremely variable and affected by a host of extraneous factors such as individual variation, weather, stage of the nest, activities of nearby jays, time of day, whether nest is first for year, etc. To judge from these two nests, about three-fourths of the time is occupied by nest-building and one-fourth is spent otherwise during the active phase of nest building. Of course the jays do not work constantly even during the attentive periods. At N6, evidently a first nest, at which an interval of undetermined length occurred between completion of the nest and the laying of the first egg, the nest building tapered off more or less gradually. At the repeat nest 3A the female continued to spend most of her time at the nest even after the latter was almost completed, and nest building gave way to broody behavior gradually.

Material for the nest was secured at any distance up to at least 100 feet. If available, twigs were sometimes taken from the nest bush itself. Twigs were secured either on or off the ground. The jays spent much time in futile pulling on live twigs and tendrils of vines. Sometimes, with one twig in their mouths, they attempted to seize additional ones and finally dropped all of them. (Precisely the same behavior occurs when they are presented with an abundance of large pieces of food, especially if more than one jay is present.) I saw a jay with one foot on the ground and the other braced at right angles against a stem pull so hard that its body was thrust sidewise against the ground.

April	Period of observation	Attentive (building) and inattentive (not building) periods; latter in parentheses. Time in minutes		Total number visits to nest (♂ or ♀) for each attentive period or part thereof	Male fed female at
10	9:15–11:46 A.M.	27+(51)73+	[67%]	3, 21	—
"	1:37– 5:30 P.M.	158+(19)31(25+)	[81%]	35, 8	—
11	9:30–11:20 A.M.	60+(29)21+	[74%]	17, 6	—
"	3:12– 5:24 P.M.	52+(43)37+	[67%]	6, 11	—
12	8:43–10:01 A.M.	42+(24)12+	[70%]	11, 5	—
"	4:40– 5:35 P.M.	(13+)1–(27)15+	[29%]	1, 1	—
13	7:30– 7:45 A.M.	(15+)	—	—	—
"	9:37–11:16 A.M.	44+(26)29+	[74%]	10, 5	10:26, 10:27, 10:47
"	5:00– 5:15 P.M.	15+	—	2	—
14	9:15–10:47 A.M.	(92+)	—	—	—
"	1:10– 1:40 P.M.	30+	—	2*	1:15, 1:28
15	9:06– 9:36 A.M.	30+	—	2*	9:12, 9:36
"	3:20– 3:33 P.M.	13+	—	0*	—

TABLE 2. Data on building of nest 3A, a second nest, which was probably begun on April 9 and essentially completed by the fourteenth, after which the female brooded most of the time. The first egg was laid on April 16. (See table 1 and also text for explanation of figures in brackets.)

* Female on nest throughout period; male brought food to nest at times indicated.

M6 contributed almost as much to the construction of the nest as the female, making as many trips, getting into the nest to work as did the female, and perhaps bringing even larger twigs as a rule. During the later stages of nest building, however, he rarely stayed at the nest long enough to do much, and if his mate was there at his arrival, he often merely deposited whatever he had brought and left immediately. At N3A, on the other hand, the female did most of the work. During the early stages M3 was quite active, but he usually stood on the rim or to one side of the nest and worked with his bill. His mate customarily hopped into the nest and worked vigorously, shaping it with her breast, wings, and feet, as well as working with the bill. Sometimes she would hop out and inspect the nest and then resume work, occasionally working constantly for as much as ten minutes, though one to four minutes was usual.

The birds do not bring material on every trip to the nest. Especially when they have been away for some time, they frequently go directly to the nest, and the female then often works for an unusually long time. At N6, after an absence, the pair often dashed to the nest bush screaming loudly (male only?) in excitement. During some inattentive periods, at least in the later stages of nest building, the birds may remain near the nest without working on it. Thus, pair 6 was near the nest from 9:00 until 11:00 on April 27, but went to the nest only three times. Only once did I see them carry material; the nest appeared finished at this time. However, this pair spent most of the time away from the nest after finishing it. On the last two days of field work, April 28 and 29, I visited this nest both morning and afternoon without seeing the birds. There was no reason to believe the nest deserted, although no egg had been laid. After marking M6 on April 24, something could be learned about their activities during inattentive periods. These they usually spent from one-fourth to one-half mile from the nest, often along the public road which offered opportunities for feeding and drinking. They usually spent the time away from the nest in feeding, preening, or, occasionally, in squabbles with other jays. The female spent more time in preening or quietly perching than did the male. Often one or two other birds, probably immatures, were feeding near them. At this time the new leaves and blossoms on the myrtle and other bushes harbored many insects, and the jays fed largely in these bushes. In this dense cover it would have been impossible to follow any species less tame and conspicuous. The pair stayed quite close together when away from the nest (within 30 feet of each other usually), and if in dense brush used low notes (*ka*), apparently as location notes. When leaving the nest vicinity or starting to return to it, either male or female might make the first flight.

On April 26 I saw a remarkable conflict of drives at N6. The male, after much tugging, secured a large mouthful of palmetto fibers. Just then F6, who had been perched nearby, flew about 100 feet from the nest. The male, instead of going to the nest, flew to a post near his mate. After a second or two he flew all the way back to a post 8 feet from the nest. He again changed directions and returned near F6 who had moved on and was now about 300 feet from the nest. I thought they would not return to the nest and followed them, but M6 came flying back, still carrying the nest lining, this time followed by F6. He stopped on a post halfway to the nest, and then went on to the nest where the material was finally deposited. They remained near the nest until I left 15 minutes later.

On April 27 they were not at the nest at 7:30 P.M., and again I found them along the public road. During the following half hour they fed in the bushes or perched quietly; the male fed the female once. When it was becoming quite dark, they took a long flight in the opposite direction from the nest. There is little doubt that they roosted at a distance from the nest, for I remained near the nest until dark without seeing them.

On one occasion a bird not his mate was observed to beg when M6 came near it with food. He ignored it and took the food to his mate. Courtship feeding with pair 6 was at long intervals, as a rule, and the female was usually undemonstrative and took the food without begging.

Nest 3A was found at 9:15 A.M. on April 10, when it consisted of a platform of about 25 or 30 twigs. Presumably it was started the preceding day. Although the female was the marked bird of N3, unfortunately this was not realized until the fourteenth. This was because the nest was in a thick bush which hindered observation, and perhaps undue caution was employed to prevent disturbance, for at the time it appeared likely that this would be the only nest found before completion. This nest was virtually completed on April 13. F3, unlike F6, spent an increasing amount of time at the nest as it neared completion. Possibly this was because N3A was a second nest, and N6 was (probably) not. On the fourteenth I found F3 on the nest at 1:10 P.M. She remained there until I left at 1:40, spending most of this time quietly sitting in the nest or on its rim, occasionally poking a bit with her bill, and more rarely laboring diligently for a few moments. At 1:32 she preened in the nest. On the fifteenth she was on the nest from before my arrival at 9:06 to 9:36, sitting quietly and from time to time working a bit. At 9:36 she left the nest but returned and hopped into it when I walked over. She did the same when I returned at 3:20. I lifted her up and felt in the nest; it was empty. She remained on the nest until I left at 3:33. She worked a little at shaping the nest. The following day the nest contained one egg.

With F3 broody behavior may be said to have commenced on the fourteenth, two days before the first egg was laid. Concomitantly the male began to feed her on the nest. All the courtship feedings observed were at the nest except the first two on April 13. In pair 6, on the other hand, none of the courtship feedings were at the nest. This was probably correlated with the fact that F6 had exhibited no broody behavior up to the time observation ceased.

EGG-LAYING PERIOD

The only observations were made at the two nests of pair 3. F3 would always permit herself to be lifted from the nest by hand, even before it contained eggs. If she was not on the nest as I approached, she would invariably fly rapidly to the nest and jump into it as though to protect it. At both of her nests incubation seemed to start with the first egg, and at the second nest, as noted above, she brooded much of the time in the days preceding the laying of the first egg on April 16. On that day the nest was observed from 1:25 to 3:15 P.M. F3 did not leave the nest during this time. I lifted her up and found one egg in the nest. She spent most of this time brooding, but from time to time hopped to the edge of the nest, inspected its interior, and worked a bit with her bill. Her mate fed her on the nest at 1:46, 2:03, 2:17, 2:26, 2:30, 2:44, 2:49, and 3:15. I visited the nest at 5:15 and 7:30 P.M. the same day; F3 was on the nest on both occasions. On April 19 there were four eggs in the nest.

In addition to F3, two other females, F4 and F5, permitted themselves to be handled while on the nest, which in the latter two cases contained young. When this was done they would fluff out their plumage and half open the bill, but without making any serious attempt to strike the intruder. This was in marked contrast to trapped jays which bite viciously. The presence of the nest in some way increases the docility of the brooding female; the same was noticed in a shrike (*Lanius ludovicianus*). M6 was trapped below the nest for marking. He was very quiet and did not bite but held a kernel of corn in his bill which he ate after I released him. Whether this meekness was correlated with the proximity of his nest is doubtful. In nonbreeding jays, which sometimes aid in feeding the young in the nest, the courtship begging and feeding, which presumably precedes and induces this behavior, may serve to mollify the natural predatory nest-robbing inclinations.

INCUBATION PERIOD

Incubation is by the female alone. The male feeds the female at the nest during incubation, although this was noted only once at N1. The female, nevertheless, leaves the nest to eat and drink. Observations on the time spent on and off the nest are tabulated in table 3.[1] The data are further summarized in table 4.

This evidence suggests that periods off the nest during incubation are of short duration. Periods on the nest are also rather short, as a rule, perhaps because it is usually very hot in the sandy scrub inhabited by the Florida jay. Incubating females often are restless. At N1 the female was apt to leave the nest shortly after being fed by the male. So far as I could see, the male did not "call off" the incubating female nor did he perch on a nearby post or bush while the female was away from the nest more frequently than while she was incubating. I never recorded courtship feeding while the incubating female was off the nest, but it probably occurs.

Sometimes the pair does not keep together when the incubating female is away from the nest, and this may be the rule. On the afternoon of April 5, F1 was not on the nest; M1 was on a nearby telephone pole and came down and scolded as I looked in the nest. F1 was apparently out of hearing, as she did not return until two minutes later.

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[1] Pitelka (1941) has suggested methods of tabulating such data. I differ with him only in believing that when the available data are rather scanty (as in the examples given by Pitelka, and in the present instance) it is better to publish them *in toto*. This is in general agreement with the recent trend towards the more complete recording of quantitative data in biological studies, and is especially important when working with such extremely variable units as attentive and inattentive periods. Here extremes and mean will often not be of great significance. When the data are so extensive that they must be condensed (e.g., Baldwin and Kendeigh's mechanically recorded data on the house wren), it will usually prove desirable to publish other statistics such as the coefficient of variation, standard deviation, etc., in addition to the extremes, mean, and mode as suggested by Pitelka

I watched F3 while she was off the nest for three minutes on the afternoon of March 31. She flew to the fire lane, found an acorn, and ate it. Then she flew across the road and drank from a leaking faucet. She recrossed the road at a point 150 feet from the nest and ate another acorn, then returned to the nest, stopping for a few moments on a post near the halfway mark. The male was not in sight, but after another inattentive period I saw him fly back with the female as far as the base of the nest bush.

If the two incubating females observed by me were representative, about 80 or 90 per cent of the time is spent on the nest during this phase. I kept no extended records of the activities of the male during incubation, but some mention of their behavior has been made in discussing other points. The males divide their time between conspicuous perches near the nest and more or less prolonged absences. During the latter they often go considerable distances from the nest, just as both birds do during inattentive periods in the nest-building phase. At N3 the male's return to the vicinity of the nest often coincided with his feeding of his mate on the nest. At N1 such feeding was observed only once. The male frequently drops down from one of his lookouts near the nest to feed on the ground nearby.

Bird	Date	Attentive periods (incubating). Time in minutes in parentheses	Inattentive periods (not incubating). Time in minutes in parentheses	Female fed on nest by male at	Number days incubation
F3	March 31	Before 3:30–3:40 P.M. (10+)	3:40– 3:44 P.M. (4)	3:39	2 or 3
"	" "	3:44–5:30 P.M. (106)	5:30– 5:40 P.M.(10)	4:06, 5:07	"
"	April 5	Before 9:00–9:25 A.M. (25+)	9:25– 9:27 A.M.(2)	9:23	7 or 8
		9:27– 9:38 A.M.(11)	9:38– 9:40 A.M.(2)	Not fed	"
		9:40– 9:52 A.M.(12)	9:52– 9:55 A.M.(3)	" "	"
		9:55–10:28 A.M.(33)	10:28–10:31 A.M.(3)	10:27	"
		10:31–10:51 A.M.(20)	10:51–10:53 A.M.(2)	10:51	"
		10:52–after 11:25 A.M. (32+)	—	Not fed	"
F1	" 6	Before 9:45–10:00 A.M. (15+)	10:00–10:02 A.M.(2)	Not fed	10?
		10:02–10:57 A.M.(55)	10:57–11:00 A.M.(3)		
		11:00–11:01 A.M.(1−)	11:01–11:03 A.M.(2)		
		11:03–after 11:15 A.M. (12+)	—		
	7	Before 9:40–9:44 A.M. (4+)	9:44– 9:52 A.M.(8)		
	7	9:52–10:05 A.M.(13)	10:05–10:13 A.M.(8)		
	7	10:13–10:40 A.M.	10:40–10:52 A.M.(12)		

TABLE 3. Data on incubation (see text and table 4).

Bird	Number days incubation	Attentive periods (incubating)	Inattentive periods (not incubating)
F3	2 or 3	106 minutes (88.3%)	4, 10 minutes (11.7%)
F3	7 or 8	11, 12, 20, 33 " (91.8%) (also 25+, 33+)	2, 2, 2, 3, 3 " (8 2%)
F1	About 10 or 11	1−, 13, 27, 55 " (78.4%) (also 4+, 12+, 15+)	2, 2, 3, 8, 8, 12 " (21.6%)

TABLE 4. Summary of attentive and inattentive periods during incubation.

CARE OF NESTLINGS

Information on feeding of the young and brooding of them was obtained chiefly at N1 and N4 and is summarized in table 5. The data are hardly extensive enough to warrant extended analysis. It is evident that the frequency of feeding the young increases as they become older. Young were fed two or three times an hour in the days immediately following hatching. This had increased to from five to twelve times an hour by the time they were over a week old. The amount of time spent in brooding decreases somewhat as the young become older, but they are shielded from the sun much of the time even when quite large. The single period of observation at N5 indicated that the young in this nest were brooded more and fed less frequently than the others observed. The oldest young studied were estimated to be about fifteen days old; I thought they would leave the nest in about another week. Rand (1937, p. 30) estimated that blue jays leave the nest at about 20 days of age. A total of 26 trips to the nest with food by males and 18 by females was recorded. The excess by the males is apparently to be attributed to the fact that the female does virtually all the brooding. When not brooding, females feed at least as frequently as males.

In the rook (*Corvus frugilegus*) Yeates (1934, p. 59) found that the female broods almost constantly during about the first nine days after the young hatch. The male brings all the food during this period. The female begs for food but eats all that the male gives her and does not pass on any of it to the young. The male feeds both the young and the female during this time.

This is not true of the Florida jay. The brooding female normally begs for food when the male brings it; but she customarily gives this food to the young. Usually the male retains part of the food and both parents join in feeding the young. Sometimes the male gives the female all the food and departs, leaving his mate to feed the young. By the fifteenth when the young in N1 was three days old, the female was definitely seen to bring food to the nest. Possibly for the first day or two the male brought all the food. From the very first the female seemed to give to the young part at least of the food brought by the male, though she may have eaten some of it.

Lack (1940) in his paper on courtship feeding did not mention the extension of this behavior into the post-hatching stage. Yet this occurs in the rook, in the Florida jay, and probably in other corvids. The brooding F4 on April 27, when her young were about 17 days old and quite well feathered, still begged audibly and fluttered her wings when her mate brought food. She was more demonstrative than F6 when the latter was nest building, but this may have been individual variation. Once I saw F4 when brooding take food from M4, hop to the bottom of the bush and then up to the nest as though she were bringing food herself and feeding the young. At this same nest on the afternoon of April 25, F4, who had been brooding, hopped to a twig a foot above the nest. M4 came with food and, since the young were uncovered, he fed them himself, although F4 begged with fluttering wings.

Brooding is regularly by the female. On April 19, M4 came while the female was away and fed the young; he then hopped onto the nest in brooding position, but at once jumped off again as though he had made a mistake, and flew. The young were brooded much of the time even when quite large. The observations were made mostly in the middle of the day when it was very hot and the brooding was presumably to protect the young from the sun. The female is apt to terminate a period of brooding at the time the male brings food to the nest. F4 often left just before her mate, after helping him distribute food which he had brought.

At N1 the female once hopped 3 feet through the nest bush, preparatory to leaving the nest after brooding. Just then M1 came to the nest, and F1 returned to it to help him feed the young. On another occasion F1 returned to the nest, and M1 immediately flew up to the nest from the ground nearby; quite possibly he had delayed taking food to the nest until she returned. On April 18, F1 on three consecu-

April	Nest no.	Age of young	Period of observation	Food brought to nest	Young brooded
12	1	Hatching 11:00 A.M.	1:24– 2:34 P.M.	? 1:41 by ♂ 2:06 by ♂ 2:12 by ♂ (2+)	1:41– 1:45 1:57–after 2:34 (59%)
13	1	1 day	1:35– 2:30 P.M.	1:36 by ♂ 2:30 by ♂ (2+)	Before 1:35–after 2:30 (sprinkling) (100%)
14	1	2 days	8:42– 9:42 A.M.	? 9:20 by ♀ ? 9:37 by ♂ ? 9:42 by ♀ (2–3)	8:48– 9:15 9:20– 9:37 9:42–? (73%)
15	1	3 days	1:40– 2:37 P.M.	2:06 by ♂ 2:25 by ♀ (2+)	Before 1:40–2:23 2:37–? (75%)
16	1	4 days	10:38–11:30 A.M.	10:48 by ♂ (1+)	10:48–11:20 11:30–? (62%)
"	1	4 days	1:30– 2:33 P.M.	? 1:31 by ♀ ? 1:44 by ♀ 2:13 by ♂ (3?)	1:31– 1:37 1:44– 1:58 2:05–after 2:23 (60%)
18	1	6 days	10:05 A.M.–12:02 P.M.	10:27 by ♂ ? 10:35 by ♀ 10:45 by ♂ 10:52 by ♀ 11:06 by ♂ 11:23 by ♂ 11:48 by ♀ 12:02 by ♂ (4+)	Before 10:05–10:17 10:26–10:34 10:52–11:02 11:06–11:24 11:48–after 12:02 (53%)
19	4	About 9 days	1:50– 3:41 P.M.	2:09 by ♂ 2:23 by ♀ 2:26 by ♂ 2:37 by ♀ 2:44 by ♂ 2:52 by ? 3:06 by ? 3:08 by ♀ 3:31 by ♀ 3:32 by ♂ (5.4)	Before 1:50–2:09 2:23– 2:26 2:44 moment by ♂! 3:08– 3:28 3:31–after 3:41 (47%)
22	4	About 12 days	10:40–11:27 A.M.	10:40 by ♂ 10:48 by ♀ 10:57 by ♂ ? 10:58 by ♂ 11:05 by ? 11:11 by ? 11:17 by ? 11:21 by ? 11:27 by ♀ (11.5)	10:48–10:57 11:27–? (19%)
24	4	About 14 days	4:30– 5:15 P.M.	4:31 by ? 4:32 by ? 5:03 by ? 5:04 by ? (5.3)	— (0%)
25	4	About 15 days	2:00– 2:38 P.M.	2:00 by ♀ 2:01 by ♂ 2:15 by ♂ 2:20 by ♂ 2:35 by ? 2:38 by ♀ (9.5)	2:00– 2:20 2:38–? (53%)
26	4	About 16 days	9:00 P.M. (dark)	—	Brooding
22	5	About 10 days	1:35– 3:52 P.M.	1:44 by ♂ 1:49 by ♂ ? 2:30 by ♀ 3:51 by ♀ (1.8)	Before 1:35–2:05 2:30– 3:50 (80%)

TABLE 5. Data on feeding and brooding at three nests. A question mark before a time of feeding means that the bird came to the nest at that time, but it was uncertain whether it brought food. Figures in parentheses are numbers of feedings per hour and percentage of time spent in brooding during each period of observation (see text).

tive occasions during the course of the afternoon left the nest and flew directly across the road to a leaking faucet to drink.

Only a little was learned about nest sanitation. In the days immediately following the hatching of the single young in N1, the parents would spend much time sitting on the nest rim, working in the nest with their bill. At N4, when the young were older, the parents frequently would peer into the nest after feeding the young. The fecal sacs were usually eaten at the nest, it seemed, but sometimes carried off. The parents at N4 would usually fly from the nest to a certain pine limb 75 feet away and wipe the bill vigorously after eating a fecal sac. The female after brooding was also apt to stretch, preen, shake herself, and scratch her head. F4 during the last days of incubation usually left the nest when I was 5 or 6 feet away. During the last days of field work, she would permit herself to be handled when brooding, fluffing up her plumage, and opening the bill. She was not too perturbed to accept pieces of bread from my fingers.

RELATIONS OF THE NESTING PAIR TO OTHER BIRDS

The Florida jay does not nest in colonies or groups, although in places where suitable habitat is restricted, conditions might simulate colonial nesting. All the nests were at least one-third of a mile apart except the repeat nest of pair 3. Some data on the relation of nesting pairs to other jays have been given incidentally in the preceding discussion, but observations bearing directly upon this question are summarized here.

As already noted, in the two instances in which a male was observed to display before a female, rivalry seemed to be incited in nearby (male?) jays. These incidents probably occurred before the pairs in question had begun nesting.

When I discovered N1, the parents scolded and two strange jays dashed up. F1 hiccuped. After flying at one of the intruders (probably the female) of the second pair, M1 hopped above the other strange jay, probably a male, and pecked at him, finally driving him to a bush 30 feet away where he was no longer resented. Similar behavior was often noted, but the aggressive behavior of the male was often so desultory that a strange jay stayed in the nest bush for many minutes.

On April 5 I had scattered a handful of scratch feed in the fire lane in front of N1 (8 or 10 feet away). At 9:57 A.M. the following day F1 was on the nest and M1 in the top of a bush above her. A third jay hopped from bushes by the nest and fed in front of the nest; M1 did nothing. Shortly F1 left the nest and fed with the stranger. Soon M1 came down and joined them. F1 flew across the road, leaving her mate and the third jay by the nest. She returned to the nest in two minutes. M1 left but returned in a minute and pecked at the strange jay, who ignored this threat. At 10:15, M1 returned after another absence and made a determined rush at the stranger but to no avail. There was a fourth jay about 50 feet away in the fire lane, giving a querulous note. M1 happened to fly past it, and she (?) begged but was ignored. The two strangers finally left the immediate vicinity of the nest after about half an hour. Two strange birds, probably these, were often in the vicinity of N1 but obviously took no interest in the nest either before or after hatching of the young. The efforts of M1 to chase them away were usually lackadaisical and often ineffective. He ignored strangers unless they were within 20 feet of the nest, with rare exceptions.

On March 30 I wired a stuffed jay on the fence 25 feet from N1. M1 on the telephone wires above ignored it. I wired the mount 6 feet from the nest. M1 attacked at once viciously and continued to strike the mount even after it was upside down. I returned the mount to the fence; it was again ignored. I removed the head of the mount and wired it 6 feet from the nest; the male attacked, knocked it to the ground, went down after it, and carried the head to bushes 15 feet away, where I rescued it. I put the mount, minus head and neck, 6 feet from the nest. The female returned to the nest, started to settle, then eyed the mount and went over and knocked off one wing and some feathers from its back. I chased her away. M1 ignored the headless mount, though I am sure he saw it. He sallied after a jay in a tree 100 feet away and then drove another strange jay from a telephone pole near the nest, and a spirited chase followed. The next day I wired a stuffed male red-winged blackbird (*Agelaius phoeniceus*) 6 feet from the nest; it was ignored by both birds, as was a pale blue shirt tied later in the same place.

On March 30 I wired a poorly stuffed jay on a limb 10 or 12 feet from N3. M3 approached, eyed it closely from 2 feet away, but did not touch it. I put the mount 3 feet from the nest. M3 pecked it on the head three times, not very viciously, then flew off. On March 31 I put the stuffed blackbird in the fire lane below this nest. M3 went down and inspected it from close range, but quickly lost interest. On the afternoon of this day, as I was making notes on incubation, M3 appeared 50 feet from the nest chasing a brown thrasher (*Toxostoma rufum*), but the thrasher later flew past the nest without further molestation.

On the afternoon of April 1, I set a poor mount of a gray phase screech owl (*Otus asio*) in the fire lane below N3. F3 stood up in the nest and eyed the owl, then flew to the ground near it, and began to screech. Her mate and a third jay flew up. F3 *immediately went back on the nest.* A fourth jay came up. The strangers scolded from the nearby bushes. M3 went behind the owl, crouched, and paused as though to "get up nerve," and then with a flip of his wings hopped over the owl and struck it on the head. The third time he knocked over the owl. I went to rescue it and backed away with the owl behind me. M3 was very excited and allowed a close approach. He flew into the bushes and began to chase the two strange jays away. Forgetting this, he and one of the strange jays flew down to the spot where the owl had been, and M3 several times picked up and dropped feathers which had been knocked from the owl. M3 then flew off and left one stranger in the nest bush and the other in the fire lane nearby. I wondered if I had confused M3 with one of the strange jays, but, no, in three minutes he came back and fed his mate on the nest. He then hopped up through the nest bush and evicted the strange jay perched on top of it, pursued it to a bush 25 feet away, and chased it from there; the other stranger had by now disappeared also.

On April 1, as I was returning along the road carrying a mounted jay, I saw a male feed a female on the limb of a pine, the latter begging loudly. They then flew across the road and the female screamed and hiccuped, obviously much agitated. I supposed she was disturbed by me, but it was the stuffed jay, as I found when I inadvertently set it on the lawn and crossed the road to observe the pair. The female was very antagonistic to the mount (a male) and hopped around it in a curious sidling fashion so as to present her back when in front of it. She hopped up from behind the mount and nipped it on the legs several times, continuing to hiccup. She flew across the road and screamed at me, then returned and pounced on the mount from above. Her mate seemed unconcerned, though he once hopped within 2 or 3 feet of the mount. I rescued the mount and observed the birds, but soon lost sight of the female. Presumably she returned to incubate on N4 which was about 60 feet away (nest not found until later). I later learned that the pine where I first saw this pair was the favorite resting and preening perch of both M4 and F4. As noted below, when the same mount was later placed near N4, it was again ignored by the male and attacked by the female. It is curious that the female of this pair seemed unusually aggressive and the male unusually docile.

On April 22 the young in N4 were about twelve days old. I placed a mount of a male Florida jay in the fire lane 15 feet from the nest. F4 soon came and fed in the fire lane, ignoring the mount; soon she fed the young and then brooded. A few minutes later the male brought food to the nest; both parents helped in feeding the young and then flew to the fire lane. To my surprise the female, who had ignored the mount five minutes before, now launched a savage attack on it; she hiccuped in a very agitated manner, once while perched on the back of the mount. The male seemed unconcerned, continued to gather food, and went to the nest to feed the young as I removed the mount. However, the presence of the male may have been necessary to release the female's attack.

At times jays which come near the nest are ignored by the owners. Sometimes the explanation may be that the intruders are non-breeding (? first-year) birds which do not constitute sexual rivals. On April 24, while I was seated about 20 feet from N4, a jay dashed up and alighted 2 or 3 feet from me and in a few seconds was feeding from my hand. M4 came to a bush above my head, and I thought that the tame jay must be his mate despite the sudden change in behavior. However, just at that time F4 was seen feeding the young. The following afternoon the same tame bird appeared. I tossed some corn in the fire lane, and both M4 and F4 as well as the strange jay fed peaceably within 2 or 3 feet of each other. This was almost the identical spot where F4 had attacked a mounted jay a few days before. *The strange jay begged every time M4 hopped near it*, but he did not feed it. I marked it to determine if it ever went to the nest to help in feeding the young, but this did not occur. I was already certain that only the parents were caring for these young. On two or three other occasions a strange jay was seen to beg from a mated male which happened to pass it, and some birds perhaps beg from every male (and female?) which happens to approach them.

Grimes (1940, pp. 433–434) found three Florida jays feeding the young in a single nest; he thought two of the three were males. Dr. A. L. Rand wrote me that he also had the impression that more than two birds were caring for the young in some nests of this species which he found. Skutch (1935, pp. 261–265) found as many as seven brown jays (*Psilorhinus mexicanus*) feeding the young in a single nest. Five of the seven were first-year, supposedly non-breeding birds, as shown by parti-colored bills. Swarth (1904, p. 31) found first-year *"Aphelocoma" sordida arizonae* to have light areas in the bill. Dickey and Van Rossem (1938, p. 409) mention the same in *"A." unicolor griscomi* and also state that first-year birds are duller in color. Although no variation in bill color was noticed in the Florida jay, some birds did look rather dull and brownish, especially on the wing coverts.

From the above evidence it would be natural to assume that the Florida jay does not nest until it is two years old and that the individuals which engage in indiscriminate begging and in feeding of young not their own are first-year, non-breeding individuals. Although some large members of the family such as the raven (*Corvus corax*) do not breed until two years old, the smaller jackdaw (*Corvus monedula*) and European jay (*Garrulus*) do so when one year old (Niethammer, 1937, pp. 3, 18, 30). The smaller American jays may be expected to nest when one year old, and F. A. Pitelka informs me that it is known that the California jay may do so. Possibly some Florida jays do not nest when a year old, but show indications of breeding behavior by courtship feeding and sometimes by feeding young. Strauss (1939b, p. 165) found that jackdaws too young to nest form pairs which engage in courtship feeding. It is also known that year-old jackdaws nest later in the season than adults (Niethammer, 1937, p. 18). Possibly Florida jays observed begging from mated adults would themselves nest later in the season. If such were the case, egg dates for the species should indicate a protracted nesting season, but this does not seem to be true. Available records of nests containing eggs are distributed as follows: 4 in late March; 25 in April; 7 in May, and 2 in early June.

Since Florida jays defend their nest and its immediate vicinity from other jays, this area is a territory. Whether it is homologous with the usual breeding territories of song birds depends, perhaps, on whether intruding jays are repelled because they are potential sexual rivals or because they represent possible nest predators. In the latter case, the jay's motive in scolding or chasing a human, an owl, or another jay in the vicinity of the nest would be the same. The fact that the female often uses the hiccup note when threatening other jays and rarely uses it in scolding other animals suggests that the jays are considered to be sexual rivals. This probability is further supported by the fact that breeding jays do not seem to resent the presence near the nest of some jays, presumably non-breeders, and have even been known to permit the latter to aid in feeding the young.

A puzzling feature of the behavior of the Florida jay is the presence of groups of jays engaged in excited screeching and chasing. Such flocks usually contain from four to twelve birds. The commonest notes then given are *krē* or *kra*, rapidly repeated. The females often hiccup in a very agitated manner. Frequently one jay in the group will be observed to pursue another persistently through the branches of the thick scrub, and sometimes longer pursuits in the open follow. Often such flocks remain at a high pitch of excitement for long periods of time, with occasional interludes of relative quiet. At first it seemed that this type of behavior might be associated with pairing activities, but as it continued throughout the period of field work this is impossible, unless the nesting season is much more protracted than seems to be the case.

N6 was found when I was attracted to such a flock of screaming jays. Two of them were carrying sticks; this proved to be pair 6. They soon revealed the nest, which was then scarcely started and contained only four or five sticks. Throughout the period of nest building a flock of excited jays was present near this nest much of the time. Pair 6 seemed to have only a secondary interest in this excitement, and the latter was certainly not initiated by any activity—territorial or otherwise—on their part. When the other jays made a particularly excited outburst of calling and dashing about, the pair would be infected by the excitement to some extent and would sometimes fly over and join the flock, M6 screaming and his mate hiccuping. Usually they would soon quietly resume nest building. Only when the other jays came within 40 feet or less of the nest, would pair 6 sometimes chase them. I noticed somewhat similar excited flocks among the blue jays which are common in some habitats on the Archbold Station, but this may have been pairing activity.

The social behavior just described cannot be interpreted until marked birds have been studied during the pre-nesting as well as nesting periods. Possibly it represents a conflict of social, gregarious drives and disruptive pairing or sexual drives. During inattentive periods the jays tend to gather in flocks, with unmated and non-breeding birds. The mated pairs react aggressively to other jays, resulting in constant turmoil. Such melees were observed several times a day. Sometimes birds were observed feeding quietly together, but rarely more than four or five at a time.

REACTIONS TO DISTURBANCES IN THE NESTING CYCLE

N3A was started only two or three days after the eggs had been stolen from N3 by an unknown predator. The eggs in N3 had been incubated for eight or nine days. The first egg of the repeat clutch was laid April 16. This clutch contained four eggs, the earlier one three. I added a fifth jay egg to the second clutch and it was accepted.

At N2 I experimented to find if this species is a determinate or indeterminate layer. This nest contained one egg on March 27; the next day there were two; I took one of them. On March 29 there was still one egg in the nest at 9:20 A.M., but evidently another was laid later in the day, as on the thirtieth there were two, one of which I took. No more eggs were laid, and the nest was deserted. The latter seemed to be done reluctantly. On April 1 both birds scolded as I looked in the nest; and even up to the fifth, one or both birds would appear and show mild concern at my daily inspections. On April 7 the nest was obviously deserted; the one egg was still in it. This suggests that the Florida jay is a determinate layer and that it will not tolerate removal of eggs which keeps the total present at one (although two eggs are not infrequently a complete clutch in this race).

I went to N1 on April 20 at 9:30 A.M. to observe the feeding of the young, but the parents were behaving abnormally, sitting in the top of the nest bush for minutes at a time. The nest lining looked slightly pulled above the level of the nest. I went over and found the one young missing. Both jays scolded; one, apparently the male, went to the nest and spent three or four minutes poking in it with his bill. I went to N5 which contained young of about the same size and put one of them in N1 to replace the missing young. It was 10:30 by the time this was accomplished and the parents were no longer around the nest. I returned at 1:20 P.M. and was about to remove the young jay from the nest, when an adult dashed up to within 5 feet. The jay went to the nest and inspected the young closely. The adult gave a low *kà, ka,* and then flew to a nearby bush. When I left ten minutes later the jay had not visited the nest again. One would think that this must have been one of the parents, but the young jay was not accepted and was found dead the next morning. The dead nestling was placed in the pen containing a pair of captive jays and the male at once ate it.

SUMMARY

The Florida jay (*Cyanocitta c. coerulescens*) was studied from March 27 to April 29 near Lake Placid, Florida. Though a short-winged species it takes many short flights and more rarely longer ones. Most of its time is spent in hopping in open areas or among the twigs of bushes in search of food or in perching. Unlike most bush-inhabiting species it is bold and becomes very tame. It buries food usually by thrusting it beneath the sand without digging a hole, but was once observed to drive a hard piece of food beneath the sand with blows of its bill. Leaves or other small objects are placed over the spot where food is buried. In searching for buried food the jay swings its head from side to side throwing the sand to either side with the bill. Hard objects are held in the feet and broken with the bill; often certain projecting roots or similar objects are habitually used for this purpose. Frustration or rage is expressed by striking on the perch with the bill and by screeching. The male is much more aggressive. Acorns presumably buried the preceding autumn were being consumed in numbers, but the bulk of the food was animal matter. Insects are captured both in bushes and on the ground, sometimes after spirited pursuits. A variety of calls, chiefly harsh, are given and also a peculiar, evidently mechanically produced "hiccuping." The latter is given usually, if not exclusively, by the female and serves as a threat to other jays and probably in other ways. A whisper song is given by both sexes and seems to express either physical well being or mild perplexity.

Males in a courtship display were twice observed to hop, with head elevated and tail spread and dragging, around females. Both of these pairs practiced courtship feeding and presumably were in a pre-nest-building or at least pre-incubation period of the reproductive cycle. Courtship feeding is continued through incubation and to some extent after the young hatch. Both sexes participate in nest building, but there is a tendency for males to do less than females. One nest was completed in six days and another in four days, although a little was added to it on the fifth day. The former was a second nest, and the first egg was laid on the eighth day after it was begun. Nest-building attentive periods varied from 30 to over 158 minutes each and inattentive periods from 25 to 113 minutes. Inattentive periods were usually spent about one-third mile from the nest; the time was spent in feeding, resting, and preening, or squabbling with other jays; courtship feeding occurred at infrequent intervals. Nest-building periods comprised about three-fourths of the total (daylight) time.

Only the female incubates. At a repeat

nest the female spent most of the two-day period between the finishing of the nest and the laying of the first egg in perching or brooding on the nest. Incubation, or at least light brooding, starts with the first egg. The observed females spent about 80 or 90 per cent of their time incubating; attentive periods usually vary from 10 to 60 minutes but one of 106 was recorded; inattentive periods are usually of less than 5 minutes. One male usually fed his mate at the nest once or twice during each attentive period, but at another nest only one feeding was recorded. The male spends much time on a conspicuous perch near the nest, but is often absent from the nest vicinity; his behavior except when feeding his mate on the nest does not seem to be correlated with his mate's incubating rhythm to any great extent.

Both sexes share in feeding the young, but the female alone broods. Young are fed two or three times an hour during the first week, and this gradually is increased to five to twelve by the second week. Up to the termination of observation when the oldest young were about fifteen days old, they were brooded more than half of the time, partly, it seemed, to protect them from the sun. At one nest the female fluttered her wings and begged when the male brought food. She usually received part of it, and both shared in feeding the young. After feeding, the parents wait for the appearance of fecal sacs; these are eaten or carried away.

During all phases of the nesting cycle jays sometimes attack other jays which approach the vicinity of their nest. Stuffed jays and also a screech owl were attacked, but a stuffed blackbird was ignored. However, some jays are ignored near the nest; such birds were apparently non-breeding birds. The latter were sometimes observed to beg from mated males but were never fed. Others have observed such birds to aid in feeding the young in a nest, but this is probably unusual. Noisy groups of jays exhibiting much squabbling and antagonism were observed daily, but their significance is obscure.

A second nest was begun two or three days after the disappearance of the eggs (incubation about eight or nine days) from a first nest. One pair deserted after a normal clutch of three had been laid, when an egg was removed from the nest each day to keep the total at one.

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A UNIQUE CASE OF CIRCULAR MILLING IN ANTS, CONSIDERED IN RELATION TO TRAIL FOLLOWING AND THE GENERAL PROBLEM OF ORIENTATION[1]

BY T. C. SCHNEIRLA[2]

Were insects unable to make and to follow trails, the problems of Victory gardeners, farmers, economic entomologists, and housewives would be considerably reduced. For in almost every insect order from roaches to the social insects there are at least a few species that reach or return to a food supply, food plants, home quarters, or other places by virtue of their ability to make and to follow trails. It is clear that an understanding of trail making and trail using is desirable for both theoretical and very practical reasons.

COLLECTIVE FORAGING AND CHEMICAL TRAILS

There are many different forms of trailing in insects, from the type of trail that is followed in a relatively rigid, stereotyped manner to routes that are used in a complicated, delicately varying manner, often by a single individual alone. Among the ants, the simplest kind is the collective trail. On such trails the workers of a given ant colony are able to reach a food place in large numbers, with a minimum of delay and difficulty once the "track" is established. In this paper we shall be concerned with collective trails in particular.

One of the least complicated ways in which such a trail may be set up was demonstrated by Eidmann (1927), using a *Myrmica* colony in a laboratory nest. With a new paper floor in place, one individual was permitted to find sugar water in a distant compartment of the nest, and feed upon it. Shortly after the finder had returned to the home compartment, a number of ants was observed to cross the floor of the intervening compartment toward the food place, taking the same route the finder had used in returning, even in its detailed turnings. The simplest explanation was that the newcomers were following a chemical trail left incidentally by the first ant. Confirmation of this interpretation was found in a further test when a clean floor was substituted for the used one after the finder ant had crossed from the food to the home base. Then other ants came out as before, evidently aroused by the returned food carrier, but this time they were quite unable to follow her path, instead wandering about and reaching the food only by chance.

Other studies throw light on how such trails are made. In work with a *Tapinoma* species, Santschi (1911, 1930) noticed that in returning from the food the first finder rubbed her gaster against the floor, evidently an outcome of her excitement which resulted in a trail of some kind. Inspecting the ground in her wake with a hand lens, Santschi actually saw tiny droplets in the line she had taken, suggesting to him that the products of the ant's anal gland had been deposited when the gaster was rubbed against the floor. Although he thought this was a "deliberate" procedure on the part of the finder, a preferable interpretation is that the lowering of the gaster and opening of the anal-gland orifice occurred merely as incidental

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[1] A contribution of the Department of Animal Behavior, the American Museum of Natural History.

[2] The American Museum of Natural History and New York University.

(i.e., as direct reflex) parts of the ant's general excitement, no more intentional than the release of sweat from the skin glands of an excited human individual. Similarly, v. Frisch and Rösch (1926) have shown that when a honeybee finds a new food place, in her excitement the products of the "scent glands" are released, greatly increasing the chance that other bees will find the place.

The present writer has observed that the findings of Eidmann and Santschi may be applied directly to the case of the small imported ant, the reddish yellow myrmecine *Monomorium pharaonis*, a common kitchen nuisance which displays a singular ability to establish collective trails to new food places. A *pharaonis* worker, upon leaving a place where she has imbibed or picked up food, generally lowers her gaster so that its tip rubs against the substratum as she moves, thereby leaving chemical traces on the return path which newcomers are observed to follow, usually with relative ease. As a result this tiny ant, wandering individually over relatively large distances around the nest, appears with surprising quickness in considerable numbers at any newly discovered source of food. This characteristic undoubtedly has greatly assisted the almost unmatched distribution of the species.

CHEMICAL TRAILS IN THE RAIDS OF ARMY ANTS

A strikingly different mode of establishing collective routes is found in the *Eciton* species, the army or legionary ants of subtropical and tropical America. Few ants follow their trails in a more slavish and stereotyped manner than do the Ecitons. For example, the raiding columns of *E. hamatum*, the golden yellow terrestrial pillager, excel in the rapidity with which new offshot columns are formed over unraided ground (Schneirla, 1938). If the routes which spring up and survive longest during a day of raiding are mapped in detail, the result is a tree-like figure. The trunk line of this trail system leads from the bivouac or home site, with more and more frequent branching as the distance from the bivouac increases. At the very twig end of the system, usually as much as 150–200 meters from headquarters at the end of a given day, the newest trails grow outward into unraided ground from which insect booty is snatched. Each twig column ends in a relatively small group of ants, a few dozen of them in an area usually not more than 25 cm. wide, behaving in a rather peculiar manner as they push onward. Hugging close to the ground with her antennae flitting close to its surface in quick spasms of wasp-like vibratory movement, each newcomer to the group meanders forward hesitantly a few centimeters over fresh terrain, then quickly turns and rejoins the base column. In this way the trails are extended onward, by a relay process in which no given ant or ants have the "lead" for very long but with many ants participating successively in the trail-blazing process.

Eciton trails frequently follow vines, the top edges of tree roots, the worn indentations of peccary trails, and other topographical features along which the ants move readily in antennal contact with a surface. However, a given trail persists and is followed by further ants because it is marked chemically, first of all by the pioneer ants (presumably with their glandular products) as they move excitedly forward, each contributing a limited extension of the track into new terrain. Experience with a given route is not necessary in the Ecitons. Any member of the colony can readily follow the trails of each part of the raiding system without having passed over the particular route previously. Thus in special tests, when workers are removed from the bivouac and placed beside any trail of the day, they readily enter and run along the route, whether or not other ants are traveling upon it at the time. Or if Ecitons are held captive overnight when the colony moves to a new locality, they are able to follow any fresh trail of the next day when they chance upon it after being released. The chemical traces evidently remain in existence for some time, despite repeated washing of the ground by heavy rains. This is shown by the fact that when colonies remain in the same bivouac location for as long as three weeks, a periodic occurrence in the terrestrial foragers at least, a long section of trail may drop out of use for two or more days after it is originally formed, then reappear in use as part of a new raiding system.

Evidence for a chemical similarity in the trails of different colonies of the same species is offered by the ability of Ecitons to run a trail of another colony to whose zone they are transferred; however, a certain chemical difference is indicated by a noticeably more hesitant progress than when on trails of their own colony. When a transferred ant encounters foragers of the strange colony she is attacked repeatedly and finally killed unless she flees the trail. Such facts, together with the results of nestmate-recognition tests in which the distinctive influence of "colony odor" has been demonstrated (Fielde, 1902; Morley, 1942), indicate that ants of different colonies of the same species vary in their immediate effluvia, as well as in the chemical nature of the routes they make. Furthermore, since preliminary tests indicate that an Eciton worker is able to follow the trail of another species (e.g., transported *E. hamatum* workers push hesitantly along a section of *E. burchelli* trail to which they have been transported), a chemical similarity is suggested for the routes of closely related army ant species.[1]

The basis of trail-following thus would appear to rest on the tendency to approach sources of the ant's own colony chemical or similar chemical patterns, and thus to move forward according to the line of this chemical when on trails. What accounts for the ability of the individual worker to respond in this highly adaptive manner?

THE ONTOGENETIC BASIS OF TRAIL FOLLOWING IN ARMY ANTS

In the case of the Ecitons it seems improbable that the mere possession of olfactory sensitivity brings with it this capacity for trail following. After hatching, trail following requires a few days to appear, and circumstances do not justify attributing the delay to maturation, i.e., simply to an improved sensitivity based upon further growth of the olfactory tissues themselves. The fact that the callows are able to run long distances when participating in the nightly bivouac-change movements militates against the possibility that it is merely muscular weakness which holds them back in the daytime. The possibility that the irritating effect of light may restrain them at first should be kept in mind; yet circumstances oppose this as the main factor. Normally, *E. hamatum* workers become fairly able trail followers after four or five days from hatching; however, the results of some preliminary tests suggest that being with the colony is essential for the improvement. After *hamatum* pupae had been kept away from the colony for a period of five days following hatching, when placed individually on the raiding trails they seemed helpless and inept in contrast to others of the same brood that had lived with the colony after hatching.

Normally, for some time after a new brood of mature pupae is removed from its cocoons by adult workers, these callows (light-colored and readily distinguished from regular workers) remain in the bivouac without venturing upon the raiding trails to any extent. Then, after a day or two, they begin to appear on trails in the daytime, and are observed in progressively increasing numbers at points farther from the bivouac. There is also a noticeable change in their behavior during this period. Upon the trails they move slowly and hesitantly at first, unable to move rapidly or to go very far in a given direction without stopping. Repeatedly bumped and shunted about by the regulars, they generally pass along at the sides of the column for limited distances, readily drifting into groups at trail-division points. Gradually their deficiency seems to decrease, until after a few days when deepening pigmentation has made their external appearance difficult to distinguish from that of regular workers, their trail running likewise is close to the general standard.

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[1] Almost a virgin field awaits investigation in the biochemistry of trail secretions in insects, and particularly ants. To the writer's knowledge, the only study of Eciton chemical is the work of Melander and Brues (1906). These investigators found no traces of formic acid in whole body distillates of various *Eciton* (*Acamatus* = *Neivamyrmex*) species of the southern United States. However, the outcome of further tests suggested that the basic substance probably is leucin.

In view of this evidence suggesting the importance of experience, the preferable hypothesis seems to be one centering around the postulation of a rudimentary learning process of the "habituation" type in which there develops an increased readiness to approach the colony chemical. In the colony, this chemical dominates environmental stimulation from the time of hatching; whether resting or feeding in the bivouac the callow is stimulated by it, as indeed she was stimulated during her active larval period. Thus it is very possible that through a simple conditioning process, perhaps begun during the larval period, the callow moves about readily in the presence of this chemical and, more important, turns toward increases in its concentration.[1] Gradually, as she moves about more freely, the new worker drifts into the trails in responding to the Eciton chemical and to the movements of departing foragers. Early bivouac life thus may lead directly into trail running, with the initial hesitancy of the callow decreasing as she becomes better trained to run freely forward in the presence of the colony chemical. This hypothesis is consistent with a theory for social insects in general which takes into account not only the original equipment and physiological maturation of the individual, but also the importance of early environment and early activities for the development of social reaction patterns (e.g., Wheeler, 1928a; Maier and Schneirla, 1935, chap. 7).

One feature of early life which must hasten the *Eciton* trail-habituation process considerably is participation in the bivouac-change movement of the colony. Regularly, when a new brood hatches, the *E. hamatum* colony shifts to a new bivouac site at the end of each day (Schneirla, 1938). At first the callows do not readily join the drift of workers from the cluster; rather they leave the interior of the bivouac passively when shunted along with outgoing groups of workers, and huddle near the exit until incidentally absorbed into the exodus. Much confusion results from the tendency of callows to hesitate, waver, and turn around when brushed or bumped by foragers returning to the bivouac. By degrees the callows are absorbed into the outgoing movement, until after a few hours they drain from the bivouac in a steady stream, moving along in a thick column with few interruptions. During the early post-hatching period callows are seen in numbers outside the bivouac only when they join bivouac-change movements; then they are able to progress in a regular manner only when conditions in the column afford an environment of uniform chemo-tactual stimulation promoting continuous movement in one direction. Running the trail under these "hand-fed" conditions would seem to contribute fundamentally to an ability to make progress in the daytime, developing as foragers under shifting tactual conditions by responding to the chemical trail itself.

The Eciton bivouac-change movement sharpens our view of army-ant progress in columns as a routine stereotyped following of chemical lines. The view is quite defensible, since under any conditions the ants are oriented mainly by the chemical path, and only secondarily by other factors. Through visual stimulation, for example, they are aroused in the morning (Schneirla, 1940) and are caused to shift their bivouacs away from bright light, yet appropriate tests on their foraging and other column activities give no evidence that visual factors are involved in orientation. On the other hand, the prevalent importance of an olfactory basis is readily demonstrated by simple tests of the "Finger-versuch" type (see Brun, 1914). Rubbing a finger across a trail causes a serious interruption, with the ants assembling on each side of the violated zone, unable to cross until the gap has been passed by some of them in a manner resembling the pioneer process of trail making. When a portion of trail on a leaf is moved laterally so that each end is a few inches from its former position, there is an interruption which eventuates in activities similar to initial trail making, with the difference that the displaced section may become part of the trail bridge if the pioneers chance to reach it. Such tests show that a chemical trail is an indispensable basis for the route. However, considerable liberties may be taken with sections of trail on movable objects, as long as the ends join the main trail somehow. In one frequently repeated test, a trail section on a long slender limb was quickly turned end for end, so that the east end touched the place formerly occupied by the west end, and vice versa. After a brief commotion caused by the lifting itself, traffic soon resumed without much difficulty. Since relatively long sections of trail may be thus reversed without blocking the ants, the Eciton path appears to be a simple homogeneous chemical track, not polarized chemically as are the trails of many other collective foragers under given conditions (e.g., *Lasius* species, Brun, 1914).

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[1] Thorpe's researches (1939) with the ichneumon fly in particular have led him to adopt a theory based upon the postulation of a chemically dominated conditioning process governing the response of predatory adults to given prey upon which the individual has fed as a larva.

CIRCULAR COLUMNS AND STEREOTYPY IN TRAIL FOLLOWING

Circular Trails in Processionary Caterpillars

The psychological limitations of insects engaging in this type of trail orientation are suggested strikingly when the insects form and continue to follow circular trails. In volume 6 of his "Souvenirs entomologiques," Fabre reported an interesting case of this type observed in 1896, perhaps the first scientific record of the phenomenon for any animal.[1] Some processionary caterpillars (*Cnethocampa pityocampa*) he had hatched were seen to form a column around the upper rim of a large vase in a circular path 1.35 meters in circumference. Fabre hastened to assist the retention of this column by brushing away all threads remaining on the sides of the vase after the larvae had mounted, and by removing all excess late comers which might have swollen the column beyond the limits of space on the rim. Once started on the endless trail, the caterpillars circled in this path for seven days, moving more or less continuously except for halts caused by low temperatures during the nights. These and many other lepidopterous larvae of similar behavior ordinarily follow one another in winding columns by virtue of contact with a thread or threads spun by those first to pass over the ground. In the processions formed by the caterpillars of the American buck moth *Hemilenca maia,* Marshall (1904) found that removing the leading individual usually served to halt the whole line in place for some time, until the "leader" was returned or until some other larvae chanced to proceed. This suggests that in this species only the first individual or the first few to pass along are actively involved in spinning, while the others merely follow the trail. Contact with the thread is not the sole factor in following the path, since when Marshall removed a portion of thread between neighboring caterpillars in the body of the procession those behind were not stopped. However, rubbing across the path with a moistened finger in addition to removing the thread brought those following to a halt, with a delay of a few minutes before the gap could be crossed. Evidently, in the buck moth at least, the trail is followed chemically as well as tactually.

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[1] A similar case of persistent circling in a *Cnethocampa* species was reported by Dubois in 1899, with a brief discussion of the track itself. There is no evidence to indicate that Dubois did not discover the phenomenon independently.

WHEELER'S LABORATORY CASE IN *Eciton schmitti*

That Ecitons may form circular processions of a kind very similar to that observed by Fabre in lepidopterous larvae was first reported by Wheeler (1910), with the following description of the behavior.

> In captivity Ecitons are remarkably restless, at least at certain times during the day. Part of a fine colony of *E. schmitti* which I kept some years ago, exhibited this restlessness in a striking and ludicrous manner. The colony was at first confined in a tall glass jar on a square board surrounded by a water moat. The ants kept going up and down the inside of the jar in files for many hours. Finally I removed the lid. The file at once advanced over the rim and descended on the outer surface till it reached the circular base of the jar where it turned to the left at a right angle and proceeded completely around the base till it met the column at the turning point. To my surprise it kept right on over the same circumference which was long enough to accommodate all the individuals. They continued going round and round the circular base of the jar, following one another like so many sheep, without the slightest inkling that they were perpetually traversing the same path. They behaved exactly as they do on one of their predatory expeditions. They kept up this gyration for forty-six hours before the column broke and spread over the board to the water's edge and clustered in the manner so characteristic of this and the allied species (*E. opacithorax*, *sumichrasti*, etc.). I have never seen a more astonishing exhibition of the limitations of instinct. For nearly two whole days these blind creatures, so dependent on the contact-odor sense of their antennae, kept palpating their uniformly smooth, odoriferous trail and the advancing bodies of the ants immediately preceding them, without perceiving that they were making no progress but only wasting their energies, till the spell was finally broken by some more venturesome members of the colony (Wheeler, 1910, p. 265).

A CASE OF ECITON MILLING IN THE OPEN

Although I had observed in detail many raids of the Central American species of *Eciton* and had frequently set up circular-trail formations with these ants in the laboratory, under natural conditions nothing but short-lived or ambiguous instances of circular-column behavior appeared until September 4, 1936, when a striking case was discovered in the laboratory clearing at Barro Colorado Island, Canal Zone. On the preceding day a swarm of the small black *E. praedator* had worked its way from the north up the laboratory hill, crossed the grounds near the cookhouse, and after passing near the west corner of Haskins Memorial Library finally dwindled out toward dusk in the general vicinity of the Chapman cottage. At 7:30 A.M. on September 4, Rosa, the laboratory cook, excitedly called my attention to an occurrence which beyond doubt was a sequel to the foregoing raid. There follows a summary of my notes.

> At about 7:30 A.M. a singular milling group of *Eciton praedator* workers is discovered on the cement walk in front of the Haskins Library (fig. 1). There are several hundred of them, mainly intermediates and large minor workers, the size classes most frequent in raids. Most of them are running in a circular column which moves counterclockwise, rotating about a small circular cluster of ants huddled in the center. Although at this time the ring varies in width around its circumference and at intervals moves rather eccentrically, these measurements are fairly consistent for the period 7:30 A.M. to 8:15 A.M.: outside diameter of the ring, 10–11.5 cm.; width of the ring, 4–5 cm.; diameter of central cluster, 1–2 cm. The outer margin of the ring is somewhat irregular, due to the frequent straying of a few ants or a ragged file of them tangentially in the direction of rotation. Usually such deviates continue moving with the column, though more slowly, and soon rejoin the principal throng. Less frequently some of them lose contact with the column, then rest in place or move about hesitantly for a time, at length blundering back where they are swept into the main activity once more. If an ant chances to set off in the clockwise direction when she reënters the rotation, her movement is soon reversed in the course of a series of contacts and head-on collisions in the throng.
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> The column does not move strictly as a unit, but at times it behaves as though two or more individual rings of ants were moving more or less independently around a common center. Although ants in files near the periphery are moving faster than those near the center, the first impression that the inner files usually complete their revolution sooner than the outermost ones is readily confirmed. Apparently as a consequence of this difference in speed, there are observable indications of friction between adjacent parts of the procession, with here and there a file in the column deviating somewhat from its concentric course as contact with ants

moving beside it at a different rate causes some of the ants to stray. Jagged irregular gaps appear intermittently between bands in the circular column when one concentric part draws briefly away from a neighboring section. Such behavior, occurring at intervals in the general movement, may contribute to a general eccentric wobbling that characterizes the movement. The deviations of sub-groups are seldom marked or lasting, yet occasionally there arises an eddy that may nearly circle upon itself, causing confusion until broken down by the persistent force of the general rotatory motion. A sub-rotation of this kind was observed at one time near the margin of the ring, a completed circling within the general movement which threatened for a time to become a persistent rival to the main action. At 8:15 when I must leave for forest observations (at the time considered more important) the central cluster of huddled ants, at first piled two or three deep, is visibly dissolving into the movement. The size of the cluster plainly decreases as more and more of the quiescent ants are stirred into action through repeated brushing of the hurrying throng against them.

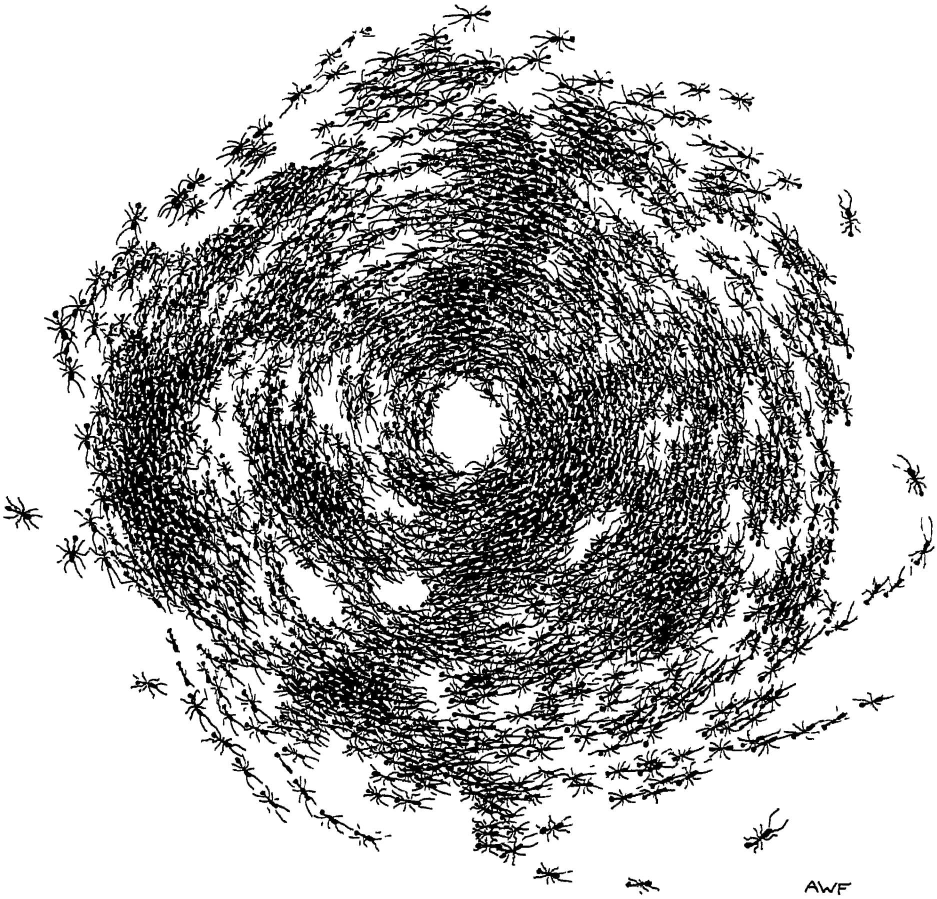

Fig. 1. The circular column of *Eciton praedator*, as drawn from a photograph taken shortly before 12:00 P.M. At that time the ring was approximately 14 cm. in diameter.

12:00 P.M.: The circular column is moving more rapidly as a whole than in the early morning, rotating as before in the counterclockwise direction. The ring has expanded, now approaching 14–15 cm. in diameter. In general there are wider intervals between its individual members, and more obvious gaps appear intermittently between concentric sub-groups. The central cluster has disappeared altogether, and there is now a bare central space about 1–2.5 cm. wide, entered only by an occasional ant which has momentarily turned too sharply to keep in touch with the innermost file. Since 8:15 A.M. the entire ring has shifted its position so that the center is now about 12 cm. from its former place, closer to the wall of the building. At 12:10 the ring is mainly exposed to direct sunlight, with only about 60° of arc on the side toward the library falling within the shade.

At 12:15 P.M. rain sets in. Ants in the mill are of course disturbed by the drops, particularly on the side away from the building. This side of the mill, although mainly protected from the direct downpour by the wide eave of the building, is still reached by a spattering of droplets which strikes the ants and dampens the substratum. Ecitons entering the exposed area soon hesitate, then are forced to move onward as others push up behind. Forced to run through the exposed area, they tend to crowd toward the center of the mill with the result that the more exposed side of the ring becomes narrower than the opposite side, and most of them turn rather sharply away from the rainy side when this becomes possible. Notwithstanding such difficulties, the rotation continues.

2:00 P.M.: (Fairly heavy rain, 12:15 P.M. to 1:50 P.M.) The place occupied by the ants at 12:00 is now thoroughly wet; however, the column continues its counterclockwise movement in a new spot 15 cm. closer to the building, where the cement is fairly dry. The group did not shift directly toward the building, but at angles in the counterclockwise direction. At 2:15 P.M. the ring wobbles as it rotates, so that its outer margin occasionally enters wet surface; in general, however, there is a small gap between its side and the wet cement. The entire assemblage moves at a slower pace than at 12:00 P.M. Once again there is a central cluster, which at 2:10 measures 4 cm. in diameter.

3:40 P.M.: (Sunshine after 1:50; now dark, beginning to sprinkle.) The circling proceeds counterclockwise, with the group about 8 cm. closer to the building than at 2:00 P.M. Some 60 of the ants have escaped the treadmill, only to wander in a loose network of columns on the outer side (i.e., farther from the building). Their number increases as the beginning of rain noticeably disturbs ants on the exposed side of the circle. (Heavy rain from 3:45–4:00 P.M.)

8:30 P.M.: Somehow the group has divided into two distinct circling rings of ants. These rings, nearly equal in size, presumably were caused by the heavy though brief rain which came shortly before 4:00. Both groups rotate counterclockwise, with their outer margins about 20 cm. apart; both nearer the wall than was the exposed margin of the single ring at 3:45 P.M. In each group a few ants occupy the central area, where they huddle together or turn narrowly in irregular ways. During an hour of observation more are shunted into the central huddle, drawn from ants in the innermost file, where many have difficulty turning rapidly enough to evade bumping by others in line. At 10:00 P.M. the two rings still rotate counterclockwise, and in both, the central clusters have grown in size. The rate of general movement has become very slow.

September 5, 6:30 A.M.: On the spot of yesterday's phenomenon little or no circling is to be seen. The entire area is strewn with the bodies of dead and dying Ecitons. A few of the survivors wander about slowly, while no more than three dozen of them form a small (ca. 7 cm. D.) and rather irregular circular column in which they plod around slowly, counterclockwise. At 7:30 A.M. virtually none of the ants are on their feet. Circling has stopped, and various small myrmecine and dolichoderine ants of the neighborhood are busy carting away the dead.

Circumstances indicate that the Ecitons must have died of desiccation, after having been in nearly constant circular motion over an essentially dry area for more than 24 hours. They might have been able to survive much longer had they not shifted their ring away from the wet each time rain broke during the day. It is probable that these ants were marooned from the evening of September 3, since the raid stopped then and no other trace of the colony was observed in the vicinity after dusk on that day.

PROBABLE INITIATION OF THE *E. praedator* MILL

Although this case may be regarded as a special instance of trailing, it is far from simple, as analysis soon discloses. Unfortunately we lack direct information concerning the initiation of the circling; however, circumstances warrant the following supposition. It is very probable that the group was an offshoot of the swarm raiding in this locality on September 3, operating at a distance from the main body and connected with it by only one or two shuttle trails when a heavy rain arose shortly before 2:00 P.M.[1] The downpour would cause the ants to cluster, as Ecitons commonly do when exposed to rain, and would isolate them by flooding the area so that the trails connecting with the swarm could not be followed. (In the behavior of these ants on September 4, especially those that strayed away from the mill, at no time was there any indication that shuttle trails were in effective existence.)

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[1] As measured by the station rain gauge near the library, 1.12 inches fell within little more than an hour before 3:00 P.M. on September 3. It is probable that the ants were cut off then, since the only other

The circling may have begun in the following manner. It is reasonable to assume that the isolated group or one main body of it was huddled in a roughly circular mass or confined to a small area during the downpour. (Such aggregations of Ecitons commonly form when rain breaks during a raid.) Then, when the rain stopped, the first ants able to run freely would be those situated on the margin of the huddle. Most of these individuals would tend to follow around the periphery of the group, through their typical response of turning toward the side of Eciton chemical and toward the side of continued tactual stimulation (i.e., furnished through brushing ants on the margin of the mass). A circular trail of Eciton chemical would thus soon be formed which these ants and newly aroused newcomers would follow in a canalized manner.

Favoring this hypothesis, there is a considerable body of evidence from laboratory observations and tests. When light strikes captive groups of *E. praedator* or others kept in laboratory nests, after a period of quiescence in darkness, a common response of those first set into action is to run around the margin of the cluster, with a persistent circular column often resulting. Occasionally contact alone is sufficient to produce this result, as was the case in Wheeler's observations of *E. schmitti* mentioned above. In his instance the ants established their treadmill around a glass jar and continued moving for 48 hours; under comparable conditions such columns may persist, though not operating continuously, for as long as a few weeks. I have observed a number of cases in the laboratory in which, for example, Ecitons would trail persistently around the lower border of their cylindrical bivouac (e.g., *E. hamatum*, housed in tall wire nests), form an endless column around the inside wall of a circular nest, or trek around objects or clusters of ants in flat glass-covered nests. In a situation of the last type, an *E. hamatum* group consisting of about 40 workers and a queen would move for hours on end in a circular path around a 10-cm. square of cellulose sponge in the center of their nesting compartment, at frequent intervals during the 8-day life of the queen in captivity. This would soon begin, for instance, whenever they were newly exposed to light. The initial runs around the sponge were slow and hesitant, mainly in contact with the sides and involving sharp turns at the corners; however within two days the route had become circular, still leading around the sponge yet not touching it.[1]

The notion that the *E. praedator* mill began through the tendency of Eciton workers always to turn toward the side on which weak tactual stimulation is offered, and to move along beside a surface which maintains this contact, is supported by the following test. When *Eciton* workers running over a table top have settled into a course along the outer edge of the table (a common occurrence with *E. hamatum*, *E. burchelli*, and *E. praedator*), a smaller circular column of them may be set up by placing a glass jar of 10–25 cm. D. near the table edge so that some of the ants brush it with antennae or legs as they

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rain of the day was a light one (.05 inch in all) coming just after 7:30 P.M. Before the latter rain came, the *praedator* raiders (as is usual) would have mainly withdrawn into their base trails and subterranean avenues leading to the bivouac.

[1] The workers in this case were responding to the stimulative effect of the queen as well as to the trail, as was shown by the fact that when she was present a compact group of them always hurried along closely behind and beside her (many clutching at her legs and body, or actually riding upon her), but always with a clear space ahead of her. When she was removed they continued to follow the trail, but now in an even column and at a slower pace. It may be added that normally the Eciton queen appears outside the bivouac only in the evening or at night, to participate in the movement of the colony to a new site. Then she follows the trail (used during the day as a raiding route) readily under her own power, accompanied by a horde of workers which greatly swells the normal width of the bivouac-change column. Far from being dragged along by workers to the new site, as many writers have assumed is the case, she furnishes her own power and usually pulls or carries workers with her. This applies to the species of *Eciton (sensu stricto)* which have been observed (*E. hamatum*, *E. lucanoides*, *E. burchelli*). In the early part of the rainy season, males have been seen following the bivouac-change route in a similar manner. It is very possible that Eciton mating occurs under these conditions.

pass. Ants that touch the jar lightly in this manner tend to leave the table-edge trail and follow the jar around its circumference, and a circular column results which in the end may absorb nearly all the strays on the table. The contact must be light, or the response is to turn *away* from the stimulated side, resulting in an eddy of the table-edge column away from the jar, but with no other change in behavior. If the jar is pushed too far into the initial column, so that the ants actually collide with it in passing rather than merely brushing its surface, they turn away and thus many get off on the vertical edge of the table, perhaps ending by the entire group trailing away on the floor.

These results indicate the great importance of positive response to weak contact in the initiation of circular columns, supporting our hypothesis concerning the "spontaneous" formation of such a column in the open. In that instance, as suggested above, a turning toward Eciton chemical must have been involved as well. Such a combination of weak contact and Eciton chemical facilitates the formation of columns of this type; we have observed this repeatedly in the laboratory. Yet the fact that light contact alone will suffice to initiate proceedings suggests that it is not so much a matter of the nature of the stimulus as it is the intensity of stimulation that arouses the approach-turning response.

ANALYSIS OF THE PERSISTENT CIRCULAR COLUMN

After the column has been active for a time, contact with the surface no longer is essential, as is indicated by the case cited in which an *E. hamatum* group trailed in a circle around a square sponge. In a more striking demonstration, after Ecitons have formed a column around a glass jar on a glass substratum, removal of the jar leaves a regular circular procession which usually is able to maintain its formation for a considerable time. The chemical trail which is formed as the ants follow the surface becomes sufficient alone to canalize the column. Thus in a number of instances, Ecitons ceased trekking around the outside edge in running around the top surface of a square wooden block, gradually shifting to a course that cut the corners more and more, until finally they followed a circular course which neared the edge only at the center of each side.

It seems clear that other factors must complicate such behavior, beyond chemical and tactual stimulation as described. An interesting instance of freedom from the original contact which led to new complications was furnished by an *E. hamatum* group first observed running around a simple partition in their shallow glass-covered nest. After several hours it was noticed that they were actually describing a parallelogram around the partition, the acute angles extending beyond the ends of the partition in the direction of turning (i.e., counterclockwise). (See fig. 2.) What happened was that after slavishly following the wall tactually for an hour or two, running speed gradually increased, and some of the ants began to overrun in rounding the corner. This brought them into contact with the side wall of the compartment, which they followed for a short distance before they turned back toward the partition (evidently responding to chemical stimulation). As their running speed increased, the ants steadily increased the distance they ran along the side wall before turning back toward the partition, and the path of their return to the partition (at first noticeably concave inward) came to be a straight line which brought them back to the partition at a point gradually closer to its opposite end. Finally the ants ran a course parallel to the compartment wall but not at all in contact with it, after rounding the end of the partition; turning from this line in an arcing course that straightened so that they neatly rounded the opposite end of the partition. At length they traced out the parallelogram with blunted corners shown in figure 2, in which they were near the partition only at its ends. In this rather complicated example, original contact with the partition and

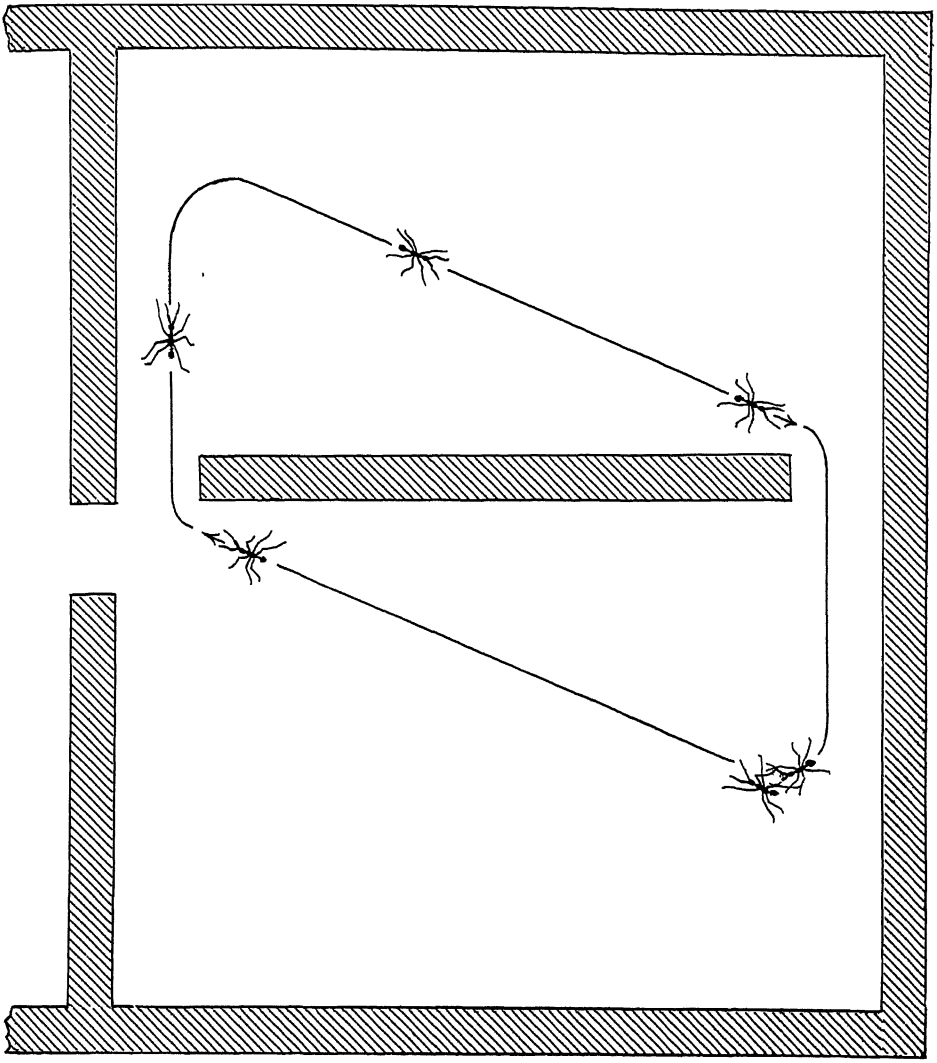

Fig. 2. Parallelogram course established by a group of *Eciton hamatum* workers around a partition in a shallow observation nest. The solid line represents the path eventually followed by the ants; the arrows indicate the direction of travel at a given time. (See text.)

newly encountered contact with the side walls were dispensed with as a chemical trail formed; however, as increasing saturation of the substratum facilitated faster running, this augmented the influence of a centrifugal-force effect generated in rounding the ends of the partition, accounting for their modifying the chemical trail to form the short sides of the parallelogram. The turn back toward the partition through what became the long side of the parallelogram may be regarded as a result of turning toward chemical stimulation when the momentum effect had weakened sufficiently.

The centrifugal-force factor, disclosed in the running of geometrical figures according to laboratory conditions, is to be reckoned with when one studies trailing behavior under natural conditions. For example, its influence is disclosed when sharp turns around objects gradually shift outward as the trail develops, until the ants finally run at a distance from the previously "hugged" surface in rounding the corner. Or at other times, when a column at first turns off to one side promptly after having reached the end of a stick along which the trail leads, the course shifts in time so that finally the turn is made in a wide arc at a distance from the end of the stick. This type of modification commonly occurs along the course of trails used for a considerable time during the day. Depending upon: the slope of the incline which is mounted or descended, the momentum which may develop through passage along a fairly straight section of trail according to the smoothness of the terrain, and the running speed which may be in force in approaching and rounding a corner, numerous features in the initial and the later form of the route may be understood. In studying trail formation, one can never afford to neglect the simple mechanical principles underlying animal locomotion.[1]

Now we are in a position to attempt an explanation of how the *E. praedator* mill was kept going for more than 24 hours in the open. It is clear from the facts that this behavior involved more than the mere following of a circular chemical track; the shifting of the entire mill through a distance of about 30 cm. within less than 12 hours dismisses that notion. However, at any given time the ants were responding to a ring of chemical, as is shown by the partial disruption of travel introduced by occasional "Finger-versuch" tests (e.g., rubbing clean glass cloth over a portion of ring area vacant at the moment). In this phenomenon the chemical factor seems to have been merged with other influences in a rather involved manner.

The persistence of this circular column may be understood in terms of the interaction of three component factors commonly influential in normal trail movements. These are: (1) a *pressure*, tactually exerted according to the principal direction of movement in the group, which minimizes variability of movement and tends to coerce "forward" progress in the group; (2) a *drainage* factor, the composite effect of chemical stimulation from the trail and tactual stimulation (as well as chemical) from travelers ahead and beside the given ant; (3) a *centrifugal-force* factor, the inertia of movement which tends to carry the ant away from the circle on a tangent with the circumference. The combined operation of these three factors holds the circular column together and accounts for the principal variations in its behavior.

The term "pressure" for our first factor is used here in the sense it was used when dealing with the phenomenon of organized swarm movement in Ecitons such as *E. burchelli* and *E. praedator*. "Its basis is the proneness of the Eciton worker to turn away from the side of strong or repeated tactual stimulation and to reverse her direction of progress if such tactual stimulation is encountered in head-on fashion" (Schneirla, 1940, p. 425). Thus through forcible bodily contact, an Eciton that happens to run against the preponderant direction of movement in a group is soon brought into line. If she happens to lag when in a hurrying column, forcible tactual stimulation from the rear spurs her onward. This factor must have played a major part in accounting for the fact that one direction of locomotion (i.e., counterclockwise) prevailed in our *praedator* mill. From laboratory observations we may say that a variable combination of circumstances (i.e., a "chance" situation) caused the majority to hit upon this direction of movement at an early point, and that deviates were gradually forced into the same direction through "pressure" until there was no longer any persistent clockwise movement in the group. A somewhat similar phenomenon is involved in a complex manner when a nomadic movement begins to develop toward evening in a raiding system of the

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[1] For example, one such effect, the role of gravitation, has been studied by Barnes (1930) in relation to the lateral oscillatory excursions of *Lasius* in running. The influence of centrifugal force as considered here commonly leads Ecitons into behavior situations resembling those described as "centrifugal swing" in the maze behavior of *Formica* species (Schneirla, 1929, 1941).

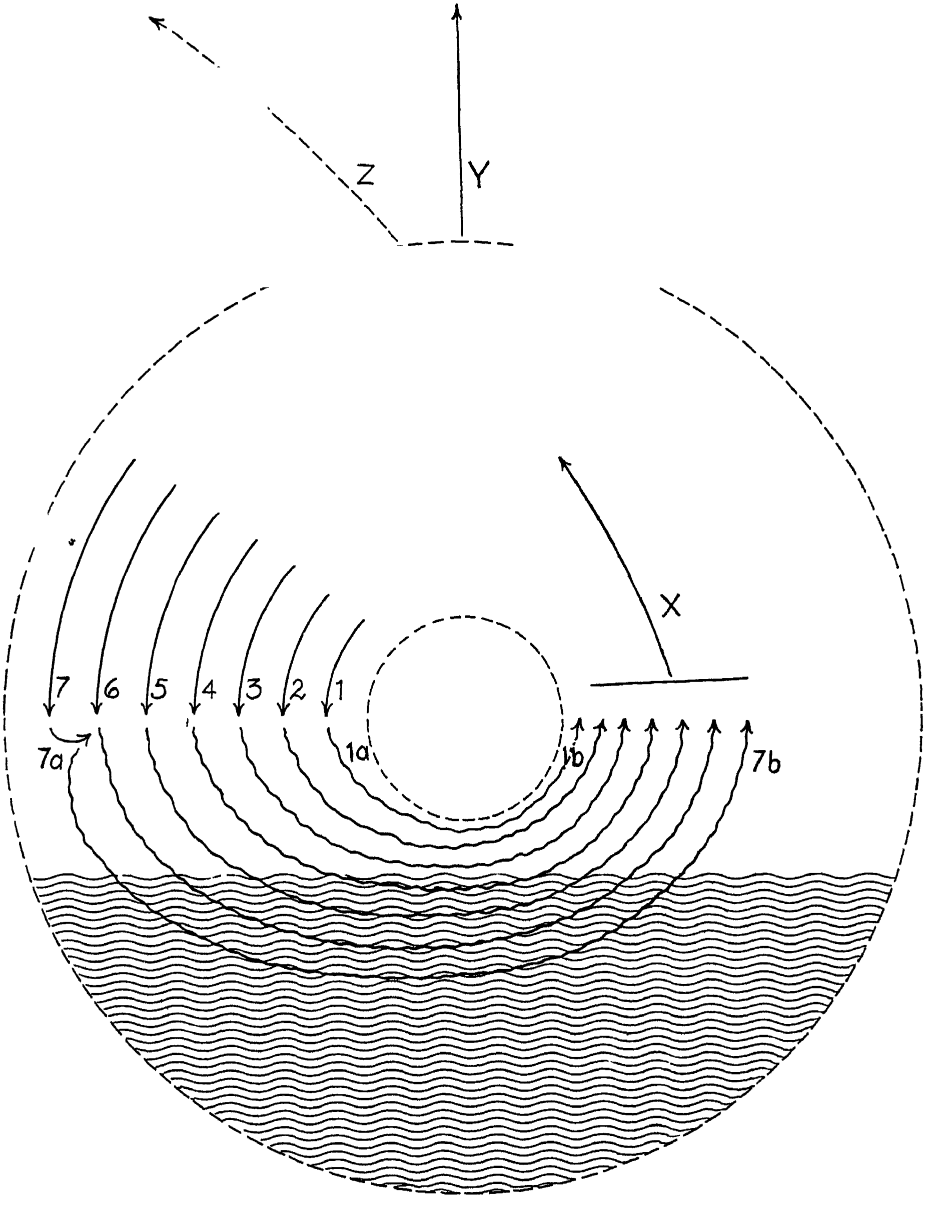

Fig. 3. Sketch representing the shift of the *E. praedator* ring as a result of wetting by rain in the area indicated by wavy lines. *1–7* Indicate the initial courses of concentrically traveling ants; *1a–7a* their respective courses upon entering the area of disturbance; *1b–7b* their respective courses upon leaving this area. *7a* Indicates how individual ants are reoriented when they turn back from the wetted surface. *X*, the vector of pressure upon the upper portion of the ring; *Y*, shortest distance to wall under the eave; *Z*, direction in which the circle shifted in response to the rain. (See text.)

swarm raider *E. burchelli* (Schneirla, in press).

Through the effect of *pressure*, in particular, one prominent change in the action of the *praedator* ring may be understood. When rain spattered upon one side of the assemblage, causing confusion and accounting for a noticeable faltering of ants entering that area, the circular column was kept in being especially through the influence of a forceful mass contact from the less exposed and more smoothly operating part of the mill. Ants that hesitated and turned when struck by rain were thereby forced to turn "forward" again and somehow rush through the damp area. Evidences of another special pressure effect were observed soon after the rain broke, an effect which seemed to contribute to the shifting of the entire circular mill toward the wall (i.e., farther under the wide eave of the building) during the downpour. Most of the ants running through the exposed area (i.e., the side away from the wall) not only speeded up noticeably, but also tended to turn short away from the side of disturbance instead of remaining in their respective concentric lines. Presently there were indications that the strong pressure effect thereby generated, concentrated upon the inner part of the circle when ants entered the drier area in the clockwise direction, was literally pushing the less exposed part of the mill toward the wall. By causing numbers of ants to run more widely outward while passing through the marginal section on that side, this unilateral pressure produced an eccentric torque or "twist" in the circling, toward the wall and counterclockwise (fig. 3). As a result of this effect and its various secondary consequences through the group, the entire mill gradually shifted its position at angles (i.e., in the counterclockwise direction, and not straight toward the wall) farther under the eave of the building. As new portions of surface closer to the building became chemically saturated by ants forced out centrifugally on that side, the entire mill could move into them, but most important, it was the dynamic interrelationship of the Eciton units in the mass that permitted the ring to retain its essential pattern throughout the crisis. Then, after the rain, it regained its earlier symmetry.[1]

Although pressure is by no means the only agency accounting for persistent "forward" motion and the minimizing of deviations, the "push from behind" plays an important part in most of the group activities of these ants and should not be neglected here. Another function of pressure in the mill, a lateral component operating centripetally, will be considered presently.

Our second factor, "drainage," also holds a basic place in all Eciton mass movements, especially in the mass organization of swarm raiding (Schneirla, 1940, p. 425). This involves the propensity of the Eciton worker to turn toward the side of weak tactual and weak chemical stimulation, or toward these in combination. This positive response to weak tactual stimulation has been illustrated in the case of a circular column starting around the edge of a glass jar. General observation supports the view that gentle contact with another Eciton ahead elicits turning toward the side from which the stimulation comes; from the same source and from special tests comes support for the tendency of Ecitons to turn toward Eciton chemical, favoring the side of greater concentration.

For example, a large strip of bristol board was prepared in an Eciton-chemical gradient by regulating the passage of workers across it to have a maximum of crossings at one end and a minimum at the other, with graded frequencies between. Then in succession 40 *E. hamatum* workers were released at the edge, 20 at the "maximal-saturation" end and 20 at the minimal-saturation end, and were permitted to cross freely. More than 15 of the former crossed at the same end of the card; whereas the latter group crossed at points extending nearly the full length of the card. Thus the representative response of ants entering the weakly saturated zone was to turn into parts of the gradient in which Eciton chemical was more concentrated.

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[1] Although the movement of the ring out of sunlight during late morning was not observed as it occurred, it seems very probable that this shift depended upon events somewhat similar to those described. The distorting effect in that case would depend upon the irritating action of bright light upon the Ecitons, causing them to speed up when entering the exposed area and turn away from the dazzle as promptly as circumstances permitted. Such responses are commonly observable in the everyday behavior of *E. praedator* swarms which are partially exposed to brilliant illumination (e.g., in sun-fleck areas).

The evident influence of the third factor, centrifugal force, is disclosed in figure 1, in which one or more lines of ants may be seen taking a path tangential to the rotating ring in the direction of turning. In the outer portion of the ring, where the ants run most rapidly, the influence of this factor is most directly apparent in behavior, in that there is a persistent tendency for the marginal ants to "fray out" from the ring in the forward direction. We have mentioned laboratory cases in which, with centrifugal force increasingly effective as running speed increases, Eciton paths around square or irregularly shaped objects approximate a circle more and more closely. Through its effect, a *hamatum* path around a linear partition (influenced by initial contact with end walls) became modified into a parallelogram (fig. 2). In such cases the interaction of our second and third factors is recognizable: a centrifugal-force effect leading the ant to run onward after turning a corner, and a response to Eciton

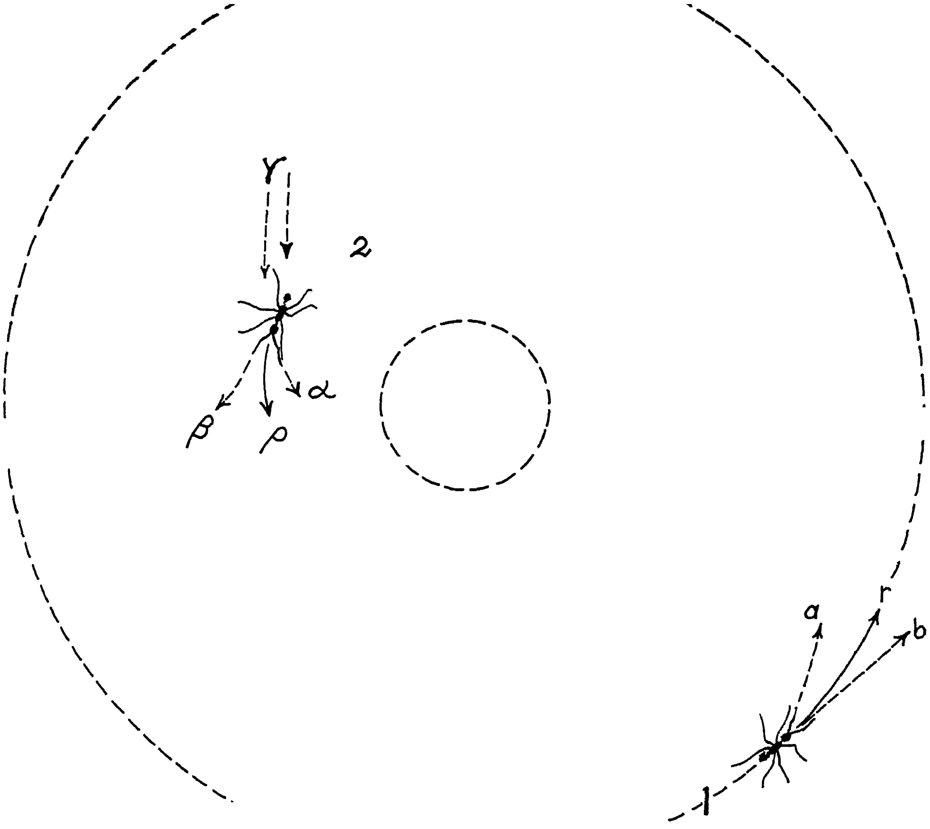

Fig. 4. Sketch to represent factors influencing the movement of ants in the *E. praedator* ring. *1*, An ant moving on the margin: *a*, centripetal vector; *b*, centrifugal vector; *r*, the resultant circular course. *2*, An ant moving in one of the inner lines: *α*, centripetal vector; *β*, centrifugal vector, *γ*, pressure from outside and rear; *ρ*, the resultant circular course. (See text.)

chemical when the centrifugal effect weakens.

To take stock, ants in the mill are kept in motion in the forward direction by a pressure from others just behind, an effect which is mutually exerted throughout the group. Upon this basis, the dynamic pattern mainly responsible for survival of the circular movement itself may be expressed most simply in terms of a combination of drainage and centrifugal-force effects. To illustrate this interactive set of influences, let us consider the case of an Eciton moving at the margin of the ring (fig. 4). Occasional contact with ants moving along on her left (i.e., inside, in the counterclockwise mill) together with a turning toward the side of distinctive Eciton chemical, would account for a centripetal vector in her movement (fig. 4, *1a*). At the same time, depending upon running speed, her momentum would account for a *centrifugal force* which would tend to impel her directly ahead on a tangent with the circle (fig. 4, *1b*). (As we have indicated, the effect of centrifugal force is directly evidenced at times in actual tangential departures of marginal ants from the ring, while the effect of the "drainage" factor is shown in the appearance of hesitancy and turning back toward the circle after short tangential excursions of this kind.) The circular course of marginal ants may be considered the resultant of these two vectors (fig. 4, *1r*).

Although the case seems more complicated for travelers on lines within the outer border of the mill, we may assume that the same *drainage* and *centrifugal-force* pattern governs the circular course of all. However, for ants moving in interior files, there are indications that *pressure* effects are superadded. In their case, the centrifugal-force influence (fig. 4, *2β*) is counteracted not only by a contact-chemical drainage effect (fig. 4, *2α*) from ants turning away on the left (i.e., "inside," in the present case), but also by pressure effects through frequent and at times forcible contact with ants running on the right side (i.e., "outside"). The circular course (*2ρ*) may be considered the resultant of these three vectors. One feature we have mentioned, the indications of "friction" between fast moving outer lines and adjacent slower moving inside lines, seems to illustrate the involvement of a bilateral tactual pattern for ants within the body of the mill. Assuredly, centripetal pressure must not be excluded here as a regulator of movement. We have noted that the circular mill expanded between 8:15 A.M. and noon. It will be recalled that a rise in temperature during this period would increase the running speed of all ants in the group, thus heightening the centrifugal-force effect tending to widen the circling of the respective concentric rings of ants.[1] But in addition, in accounting for the expansion of the mill, it seems necessary to consider the possibility that "inside" ants, by exerting an increased centrifugal pressure, facilitated the wider turning of outside lines; and that outside lines, in arcing more broadly, thereby reduced centrifugal pressure and permitted freer action to those within.

Now we may consider the Ecitons caught in the innermost line, near the hub of the wheel. We have remarked the fact that in early morning, near the end of the rain, and toward evening a central cluster was formed. At other times the central area was essentially bare, and when empty it was also larger. These were the times when higher temperatures accounted for a faster rotation of the mill as a whole, which checks with our suggestion that the faster motion of individuals increased the centrifugal-force effect and thereby spread the ring. However, when the ring contracted, individuals in the innermost line were forced by crowding (i.e., lateral pressure) of ants in the next outer ring to turn very sharply. This meant that some of the central ants were buffeted and crowded so forcibly that they were caused to circle in place. Turning variously at different angles these ants interfered with one another, an organized circling of the innermost members thereby became impossible, and they presently were thrown into a cluster. Very probably the relative sluggishness of the ants at such times (i.e., in lower temperature) contributed to the clustering tendency. Similarly, in normal foraging, when the coming of dusk slows the Ecitons, the nucleus of clusters at trail junctions is formed by disoriented ants caught and knocked about in the hectic traffic at such points. We may say that Ecitons in the center of the narrowed *praedator* mill were passively tossed about by a movement in which they could no longer participate as synchronized units, and thus in a sense assumed the rôle of flotsam in the center of a whirlpool.

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[1] Shapley (1920) and others (Miller and Gans, 1925; Pratt, 1925) have shown for various species that the speed of ants traveling an established path increases with the temperature up to a given maximum.

Milling in Relation to Trailing Under Natural Conditions

Instances of this kind in animal behavior are arresting not simply because of their bizarre character, but also because they may be utilized to review the factors of normal behavior in relief, as it were. In this example we have seen the operation, under special conditions, of the principal factors in everyday Eciton mass movement, i.e., pressure and drainage, together with the centrifugal-force effect. Studies of other *Eciton* species have shown how these factors are involved in the formation and use of ordinary raiding trails (Schneirla, 1938). Furthermore, the same concepts make understandable the integrative processes involved in the surprisingly direct advance of the relatively enormous *E. burchelli* swarm (Schneirla, 1940) and the smaller swarm of *E. praedator*. Despite very complex and at first sight utterly random eddying and cross-current movements among sub-groups in the swarm, by virtue of describable relationships of the pressure and drainage factors the whole body of ants is capable of a fairly straightforward advance through vegetation and over broken forest terrain. In the wake of every swarm there is a long fan-shaped network of columns (consolidation fan), which narrows posteriorly into a single column communicating with the bivouac. It is a relatively constant pressure, operating through this system and applied more or less evenly across the rear of the swarm by ants arriving from the bivouac, which enables the raiding mass to hold its laterally extended formation and at the same time continue its advance.

Why ants behind the swarm do not continue to roam throughout the wide lane saturated chemically by the swarm, but instead confine themselves to a progressively narrower channel at distances farther in the rear, is explicable in terms of gradual changes in chemo-tactual response with further use of the ground. A turning of Ecitons toward others, thus as a rule keeping to circuitous columns and not spreading out widely, is noticeable in the rear of the swarm where forces are reduced in numbers. The center of the area is favored presumably on a chemical basis. Because of the way the swarm moves ahead, spreading out alternately on the flanks but with a fairly consistent crowding in the center, there is evidently a reduction in chemical saturation from the center toward both sides in the area pillaged by this body. Ants coming up in the rear evidently respond to this gradient by turning more readily toward the center of the wide lane than toward its borders. Their movements on the ground by favoring the central part increase the steepness of the gradient, thus provoking still more precise turns centrally by ants advancing behind them in the fan. At the rear of the fan, where the gradient must be steepest, all lateral trails disappear from use, as a rule, and only a narrow central route remains. In the behavior of Ecitons following this principal trail between bivouac and raiding front, there are many indications that the route is responded to as the region of greatest intensity in a bilaterally extended chemical gradient. A crowding away from the edges toward the center of the path is noticeable in moments of traffic congestion, especially when the route is new, and the fastest moving ants generally usurp the midline at the expense of burdened ones or slower moving individuals such as the clumsy major workers. Displaced laterally from the trail a few centimeters or more, in the ensuing rambling of the Eciton there is a noticeable drift toward the main path, even if it is empty at the time. Displaced on the original ground, ants return to the central route far more quickly than when transferred to new ground with the trail (e.g., a section of it on a narrow leaf) located at a comparable distance.

Now although Ecitons are undoubtedly among the simplest of ants, psychologically considered, highly stereotyped in their activities, yet to the writer's knowledge a true circular mill has been observed in only this one instance under natural conditions. The *burchelli* or *praedator* swarm as it advances exhibits countless instances of vortexes, whirls, and eddying movements of short columns in the mass. Also, pushing out from the forward and lateral margins of the swarm are "pseudopodic columns" which frequently take eccentric courses, even looping back toward their origin points at times. When the consolidation fan takes form on ground first swept by the swarm, in its complex anastomosis there are always numerous remnants of circling courses formerly apparent in the swarm (Schneirla, 1940, fig. 1), which stand out for a time as loops and circular trails in the network. At times, on these circuitous portions of the system, one observes that given ants or trains of ants may travel one or more rounds in a loop before there is a change. However, in these cases, as when comparable circuits happen to form in the tree-like trail systems of *E. hamatum*, the complexion of events soon modifies the circular path, so that true milling does not occur.

Actually, although all the chief factors underlying our instance of milling are readily recognized in trail following under natural conditions, circumstances operating in the forest environment militate strongly against any possibility of Ecitons being caught in a persistent local circling movement. Either the pressure of ants entering over connecting trails changes matters, or, if few newcomers arrive, the shuttle trails provide escape routes. The raiding system of any *Eciton* species is a complex network of chemical trails connecting with the bivouac over well-traveled trunk routes, providing slight opportunity for any section of traffic to operate independently for long without being modified through its connections with adjoining sections. For this reason, no part of a raiding system can remain very long in a given pattern of action. In the case of our *praedator* mill the exception occurred, but there another unusual condition happened to be fulfilled: the ants were cut off from their colony when on or near *very homogeneous terrain*, the cement walk. Here the substratum was tactually neutral, presenting no irregularities which could intrude upon the symmetrical operation of pressure, drainage, and centrifugal-force influences around the ring. Afield, few if any situations ever approach very close to neutrality in this sense. To be accurate, the cement surface on which our *praedator* group chanced to rotate must be considered a quasi-artificial situation.

We find essentially the same idea in Wheeler's (1928b) interesting discussion of polymorphic specialization in ants, applied to the worker major of the harvester *Pheidole*.

> "Some authors regard the soldiers, the highest high-brows of our ant series, as monstrous, or pathological forms on account of the excessive development of their crania. Certain facts might seem to lend support to such an opinion. If the soldier of *Ph. instabilis* be placed on its head on a perfectly smooth, hard, horizontal surface, the insect may be quite unable to right itself and may even die standing on its head. But this is a typical laboratory experiment. In its natural environment the soldier never encounters such surfaces. Closer study shows that all these supposedly monstrous forms are really exquisitely specialized and adapted for the functions they have to perform in the life of their respective colonies. The soldiers of the harvesting Pheidoles and Pheidologetons are needed not only as seed-crushers, but those of the latter genus have another very different function. Several observers have seen groups of the minute Pheidologeton workers sitting quietly on the huge heads of the soldiers and riding to and from the nest. The soldiers of the insect-eating Pheidoles dismember the tough prey before or after it has been carried into the nest... ." (p. 19).

RELATIONS TO MILLING IN OTHER ANIMALS

Parr's Analysis of Milling in Schooling Fishes

After the foregoing analysis of the Eciton mill had been sketched, in a search of the literature for cases elsewhere in the animal series my attention was drawn to a similar phenomenon in schooling fishes, described and analyzed by A. E. Parr (1927). A comparison of the Eciton mill in figure 1 with the sketch of one level of Parr's fish mill in figure 5 indicates a marked resemblance in these patterns of invertebrate and vertebrate behavior. Even more striking are the similar outcomes of analysis by the two investigators. Each of us evaluates his phenomenon as essentially one in the mechanics of animal locomotion in relation to available sensory patterns; each develops an explanation inductively from the known properties of the animal. Of course the Parr analysis takes priority as a theory of milling behavior in inframammalian animals; however, mention of it has been delayed until this point in order to emphasize the fact that a second investigator, working independently with very different material, arrived at a theory which, notwithstanding the different setting, bears a surprising similarity to the Parr "bio-mechanics" explanation.

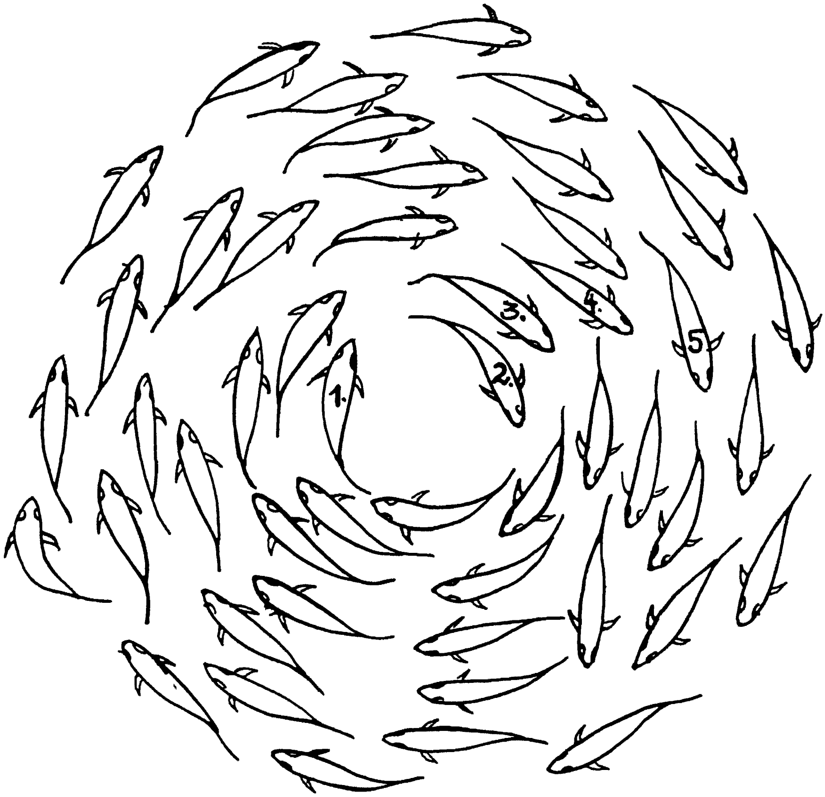

Fig. 5. Sketch of the circular fish mill described by Parr. (See text.)

The theory offered by Parr to account for the formation and maintenance of a milling group of fish may be represented in résumé as follows. When a school of fish (e.g., mackerel) meets a deflecting surface and begins a sharp turn, individuals first to head in the new direction are presented with a potent visual stimulus from those directly opposite and traveling in the original direction. This stimulation dominates over that from adjacent fish which have participated in the turn and are swimming on the outside in the new direction. Since the stimulative influence of companions swimming in the same direction is already adjusted to, the new stimulus is "much stronger" because it represents a more rapidly shifting pattern. Hence fish on the inside of the wheel continue to turn toward the inside. The nucleus of a mill is thereby formed through this mutual visual stimulation which keeps fish in the interior file turning toward oppositely swimming fish (fig. 5, *1* and *2*). Soon individuals in files next the new center become influenced by the central individuals turning away from them interiorly, and they respond by turning toward that side, thus beginning to wheel on the same principles as those causing the first circular movement of the central file. In each case, a similar turning of the adjacent outward companions in the school (fig. 5, *3*, *4*, and *5*) prevents their stimulus effect on the given individual from opposing that of the adjacent interior file. The mill is maintained on the same basis: the circular movement of the central file acquires the nature of a continuous automatic process, and the tendency to turn as originally transmitted outward is maintained as each fish continues to respond to the inward turning of its adjacent inner companion. Once the mill is formed, the outermost file exerts a certain condensing influence upon the moving group, since the peripheral members are influenced solely by a one-sided attraction toward companions turning away on the inside, and thus act as a wall restraining any individuals happening to stray outward from interior files.

A Comparison of Milling in Fishes and in Army Ants

These phenomena of circular milling in schooling fishes and in army ants are strikingly similar, as a comparison of the respective analyses above suggests. In particular, in both cases a tendency to turn toward a dominant centripetally operating stimulation seems to be paramount. However, there are a number of differences worthy of consideration. One is in the dominant sensory mechanism of the milling, which in the schooling fishes thus far studied (Parr, 1927; Breder and Nigrelli, 1935; Shlaifer, 1942) has been identified as vision. In connection with his study of mobile aggregations in the herring *Jenkinsia*, Breder (1929) has pointed out that fishes schooling on the basis of vision approach only as close to one another as the distance at which clear optic resolution occurs. At shorter distances a negative response is given. In contrast, the army ants maintain their formation in dependence upon a pattern of diverse tactuochemical stimulative factors. This undoubtedly admits certain differences in the detailed mechanism of circling, such as the influence of a tactual "pressure" from behind and from the next outer file in the Eciton mill, not demonstrable in the fishes. Although from Parr's analysis this factor of proximal stimulation would seem negligible or absent in the visually based fish mill, it is barely possible that it may acquire at least a limited importance in the exceptionally dense mills formed by the more tactual catfishes (*Ameirus*). When in schools, as Parr (1927) states, young catfish are spaced at intervals governed by the span of their tactile barbels.

This difference in the dominant sensory modality may be involved in accounting for an apparent difference in the initiation of mills in Ecitons and in fishes. As far as our cases go, the circling in visually dominated fish appears to begin centrally and grow centrifugally, whereas through various relevant considerations we were led to regard the *praedator* mill (not observed in its origin) as having begun peripherally and developed centripetally. Of course, it is quite possible that more extensive studies may show that the mode of initiation, central or peripheral, is not an invariable matter for either animal. Of far greater importance than this is the above-mentioned similarity in the maintenance of the two mills. Both may be understood as cases of predominantly unilateral stimulation of involved individuals, with Ecitons turning in stereotyped manner to the side of light contact and more effective Eciton chemical, the mackerel toward the side of visual stimulation.

Other differences between the milling of these two animals deserve mention here. An obvious difference is that although fish schools and milling when it occurs commonly operate in three dimensions, the Eciton mill is necessarily a two-dimensional affair which is more rigidly localized in one plane of space. This suggests a further prevalent difference which very probably is important for the frequency with which milling occurs under natural conditions, that is, the relative heterogeneity of the two-dimensional working surface of the ants, in sharp contrast with the great homogeneity of the aquatic medium of pelagic fishes. A homogeneous environment tends to accentuate and to facilitate stereotypy in behavior, by permitting the peculiarities of the animal to establish relatively rigid patterns which dominate its behavior in given monotonous ways over considerable periods of time. In contrast, notwithstanding the fact that the properties underlying Eciton behavior are in themselves highly conducive to stereotypy (Schneirla, 1940, pp. 447 ff.), the varying situations of a tropical-forest environment militate strongly against the persistence of monotonous patterns such as the circular-trail formation. It is otherwise with fishes such as the herring, which not only possess the organic prerequisites for stereotyped behavior, but also happen to live in an environment which admits the predominance of these properties in given patterns for considerable periods of time.

CONTRASTING PATTERNS IN ANT ORIENTATION IN RELATION TO MILLING

Actually the mechanism of Eciton orientation, although complex in its own terms, represents nearly the extreme of simplicity in ant way-finding. It bears a close relationship to the stereotyped modes of orientation which characterize the invertebrates in particular, reaction types which, although highly involved, have been studied very successfully through the experimental examination of direct relationships between the energy pattern of stimulation and the dynamics of locomotion.[1] The Eciton system of orientation reduces essentially to a generalized chemo-tactually controlled pattern, apparently without much learning involved beyond the initial approach response to Eciton chemical. Contrasted with the cases of many other collective foragers, especially among the social insects, this army ant system appears highly rudimentary.

Formicine orientation on its higher levels exemplifies the condition which Maier and Schneirla (1935, chap. 7) have termed "provisional orientation," in that the animal's behavior in a given field of stimulation is dominated in appropriate and plastic ways by circumstances which initiated the trip, and by a capacity to modify the route through previous experience in the situation. For example, the common garden ant *Lasius niger americanus* runs its trails according to the prevailing circumstances of chemical, visual, tactual, and muscle-sense (kinesthetic) stimulation, improving through learning in successive runs over the same general route. Since Lubbock's pioneer studies (1882), it has been known that *Lasius niger* follows its trail not on a chemical basis alone, but also according to the direction of light rays. Although there are grounds for believing that the *Lasius* forager may learn to move according to these sensory patterns, there remain largely unanswered a number of questions concerning the ant's ability to adapt her movements to changing outer conditions. One such question concerns how this ant

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[1] For a survey of evidence on these basic forms of orientation, see in particular the valuable work of Fraenkel and Gunn (1940).

(together with a number of other species of similar foraging activities) is able to use a given route through a considerable period with light direction one of her orienting cues, notwithstanding a gradual change in the angle of the sun's rays through the period. Part of the answer seems to lie in their ability to utilize particular serial tactual cues such as the edge of a boulder or stick in a given section of terrain. Furthermore, in certain localities they may learn to depend upon slope of the ground as one cue, and Brun (1914) showed that *Lasius* adapts differently to such properties according to the nature of its relatively broad chemical trail. Also, if the ant returns repeatedly from feeding on nectar, there arises an end-for-end (i.e., polarized) difference in the chemical trail to which she becomes able to respond (for example, she readily differentiates the two directions after being displaced from the trail). If, however, larvae (*Lasius* larvae, experimentally placed at a distance) are being carried back to the nest, she becomes more dependent upon the non-chemical cues (e.g., direction of light) and becomes seriously disoriented if light, tactual cues, or slope of the path is changed. In contrast, Ecitons, as we have pointed out, follow their foraging trails mainly on the basis of a generalized ability to move toward a common chemical product. In their case an ability to learn a particular route according to direction of light or other special cues existing on the given pathway seems to be absent, as far as the writer's tests have shown.

Thus the Ecitons represent the primitive type of collective foragers among ants, which follow their trails in a slavish, stereotyped manner without the involvement of a special learning of the route, while *Lasius* represents the more highly specialized type of collective forager which is capable of learning a route in dependence upon prevailing sensory conditions. Under appropriate conditions Ecitons follow a circular trail persistently, but we may venture to say that no particular success would meet an attempt to elicit such behavior when *Lasius* individuals are the subjects.

The contrast is even greater if we compare simple collective foragers such as *Eciton* with true individual foragers such as ants of *Formica* or *Camponotus* species. These ants are capable of learning individual routes to foraging areas in different directions from the nest, and can get through despite terrain changes (e.g., digging up the ground, laying down new surfaces) which would completely block *Eciton* or most collective-foraging ants. Field tests show that a *Formica* individual may set off from a food place toward the nest (50 yards or more away), first traveling mainly in dependence upon a clump of trees (visual stimulation of the ocelli), then pass through a low stretch of terrain mainly in dependence upon direction of light (stimulation of the compound eyes), then shift mainly to chemical cues upon a broad "ant road" a dozen or more yards from the nest (getting through on a visual basis if the ground has been disturbed), and finally reach the entrance to the nest by utilizing tactual cues, slope of ground, and a chemical gradient in complex combination (see Brun, 1914; Schneirla, 1929). In the laboratory, *Formica incerta* subjects are quite able to master a fairly complicated maze even when diffuse illumination reduces visual cues to a decided minimum and chemical cues are rendered highly unstable through frequent shifting and changing of the alley linings (Schneirla, 1943). Attempts to secure a mill phenomenon comparable to the *Eciton praedator* circular trail could never succeed with ants of these species.

Thus among ant species one finds a relatively wide range of foraging patterns, from a stereotyped following of mass chemical trails to a highly specialized learning of individual routes largely independently of any chemical tracking. Of course, a detailed study of phenomena such as the Eciton circular trail shows that even the "elementary" types of trail-following behavior are far from a simple matter of running along a line of chemical. However, in *Eciton* species the milling phenomenon discloses susceptibilities for stereotyped behavior which are truly representative of characteristic psychological limitations appearing in their normal foraging activities. We have ventured to predict the impossibility of obtaining a true case of milling behavior in more advanced collective foragers and in individual foraging species of ants, mainly because of their capacity for variable behavior in way finding which largely excludes such activities.

CONCLUDING REMARKS

Studies of mass behavior phenomena such as milling make their chief contribution in the light cast upon the general problem of levels of integration in social behavior. It is not the pattern in and for itself, but its relation to other properties of individual and group behavior in the same animal, which merits special investigation.

The milling pattern arises when animals moving within the same area yield in common to the influence of routine stimulus-response mechanisms arising through group locomotion. These characteristics mark it as a very rudimentary form of group organization. In themselves, circular columns and other types of milling are simply monotonous group activities of little immediate adaptive significance save for the expenditure of energy, standing very low in the general scale of group-behavior patterns.

As for the eventual adaptive value of milling, in different cases it may be positive (e.g., by increasing protection from enemies), negative (e.g., by displacing essential behavior functions), or may have no special significance. The biological value of such group behavior, a problem of considerable importance, must be worked out in terms of the general life economy of the respective animal forms in which it appears. In the present connection interest attaches to the nature of milling and its relation to other behavior resources in the given animal.

Analyses of milling in two animals have shown us that in such group functions the component individuals are dominated by action-engendered stimulus effects to which they respond in very reflex-like ways. Studied in itself, obviously, this type of group behavior does not necessarily provide us with a true picture of the given animal's capacities for more versatile adjustments under different conditions. It is apparent that the mere occurrence of the milling pattern may be a misleading sign of psychological inferiority, since it may well obscure capacities for plastic, opportune adjustments not dominated by those native factors which account for milling.

It happens that the army-ant circular column really typifies the nature of the animal, even though *Eciton* milling is undoubtedly rare under field conditions. Detailed study of Eciton behavior under forest conditions shows that the individual is subject to fixed and prevalent, intrinsic (i.e., native) limitations canalizing its behavior quite narrowly. However, in its complex environment, the animal is provided incidentally with innumerable possibilities for variation in behavior through the heterogeneity of forest and jungle terrain. Such diversity in surrounding stimulation permits a limited repertoire of stereotyped individual reactions to function in the group setting in highly adaptive ways. Any beginning of monotonous behavior, as we have seen, consequently is certain to be interrupted in some manner, so that it becomes merely one of a series of diversified events in the *Eciton* raid. Thus it is environmental change that frees this animal from the direct consequences of its native individual limitations.

The frequency with which milling and similar rudimentary group functions appear in any given animal must be held as a fact of uncertain significance, until the limitations of the animal and its potentialities for new adaptive behavior are better known. For example, the fact that milling occurs with considerable frequency in schooling fishes is, of course, no certain indication that they stand psychologically below army ants, in which we have found the potentialities for such behavior great, although milling itself is highly exceptional under natural conditions. To be sure, the capacities of some fishes such as the herring do appear to be rudimentary and highly limited, yet there are other schooling fishes in which milling occurs frequently, although at the same time the resources for variable and complex behavior are definitely wider than in the herring (Breder and Nigrelli, 1935).

On its face, then, simplified group behavior such as milling suggests merely a capacity for a psychologically reduced behavior under the given conditions. With respect to the general problem of social behavior, it is a reasonable proposition that the appearance of such elementary group patterns may disclose psychological limitations which are binding lifetime limitations, or may indicate merely a special propensity for routine mass activities under particular conditions, with a possible capacity for higher type adjustments when occasion warrants. Unfortunately this principle is frequently neglected in sociological writings.

In mammalian groups, the milling type of behavior has been featured in folklore presumably because of its spectacular character, as in descriptions of massed bison rushing in a frenzied stampede from prairie fire, sheep jumping fences blindly in column, and other instances of pell-mell surging by a horde of animals. This scarcely represents the normal and typical state of affairs in an adequate way. The scattered literature (Alverdes, 1927; Murchison, 1935) suggests that responses to the movement of other animals keep the group together and thus provide a basis for its activities, yet the simple stimulus-and-response relationships of mass formation appear to occupy a subordinate rôle in the ordinary activity patterns of any mammalian aggregation. It is mainly at times of sudden and great excitement that the highly simplified milling pattern dominates group behavior to the exclusion of other factors. For the most part, group activities in lower mammals appear to be plastically adaptive and rather finely adjusted to the given situation, as is evident from careful studies such as Darling's (1937) work with red deer and Carpenter's (1934) with howler monkeys. In general, the milling pattern seems to be a highly subordinate aspect of herd behavior in lower mammals.

It is a matter of considerable interest that an animal as limited in its capacity for new learned behavior as the army ant seems to be may largely escape the non-adaptive consequences of great susceptibility for circular-pattern mass activities *only* by virtue of the incidental fact of environmental heterogeneity. In contrast, the far superior resources of mammals for trial and error learning are available, in addition to mere ecological variety, for admitting appropriate group adjustments that largely hold the milling type of behavior in the background. This should be the case in their group activities in the natural environment, where opportunities to learn new patterns are not subject to the limitations that hold in barnyard and stock pen.

It may be observed that the point applies even more emphatically to the social potentialities of man himself. Yet from the point of view of what may be termed the "herd instinct" school of sociological theorists, certain writers (e.g., LeBon, 1917; Trotter, 1915), operating on a subjective and non-experimental basis, have insisted upon the inevitability of emotionalized, individually degraded, regimented patterns in the group behavior of mankind. We find Trotter carrying the notion of "herd impulse" to the extreme of assuming that human subservience to the attitudes of the group is inborn, with the child instinctively responsive to what Trotter mysteriously calls the "voice of the herd." This idea is comparable to that other hoary mysticism, the "gregarious instinct," which accounts for animal aggregations by postulating an inborn tendency to aggregate.

On whatever level of the animal series we work, a scientific approach requires us first to examine the causes of monotonous patterns such as milling when they appear, then to study their relation to the potentialities of the animal for other types of behavior. From this point of view, it is apparent that the "herd instinct" school has erred not only in evading the question of how such behavior originates, but also in underestimating the resources of higher animals for group versatility under new conditions. Particularly in the case of man, when milling behavior becomes undesirable or obnoxious, it is well to consider the canalizing, straitjacket influence of social institutions fostering group tendencies for such behavior. An enlightening study of such influences as prevalent in contemporary Germany has been carried out by Freeman (1940).

It may be observed that while army ants are constitutionally susceptible to the predominance of circular-column behavior and can be freed from it only by the incidental fact of environmental variation, man is by no means susceptible in the same sense, with his cortical basis for versatile corrective patterns which under encouragement may reduce milling to the minor rôle of an occasional subway rush.

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NEW GECKOS OF THE GENERA *AFROEDURA*, NEW GENUS, AND *PACHYDACTYLUS* FROM ANGOLA

By Arthur Loveridge[1]

Recently when I was on a visit to New York, Mr. Charles M. Bogert invited my attention to two Angolan geckos secured by the Vernay Angola Expedition that he had reason to believe were new. As I was then engaged on revisionary studies of African Gekkonidae, Mr. Bogert, with characteristic generosity, suggested that I should describe them and placed at my disposal the remarkably fine drawing of one already prepared. I was glad to accept his offer, for it provides me with the opportunity to associate his name with the most northerly African record of a genus, hitherto regarded as congeneric with the Australian *Oedura* of Gray, 1842, but which may be known as:

AFROEDURA, NEW GENUS

Genotype: *Afroedura karroica bogerti*, new subspecies.

Diagnosis: African geckos, previously referred to the Australian genus *Oedura*, form a fairly homogeneous group which may be distinguished as follows:

One to three pairs of scansors beneath fourth toe; tail verticillate (not noticeably so in *pondolia*); range: southern Africa.... .... *Afroedura*
Four or more pairs of scansors beneath fourth toe; tail not verticillate; range: Australia.......... .. .. *Oedura*

The term "scansors" is here proposed for those specialized subdigital scales which have sometimes been referred to as "adhesive lamellae," but frequently as just "lamellae," resulting in confusion with the simple lamellae beneath the basal portion of the digit.

In its tail, *A. p. pondolia* (Hewitt) of Natal most nearly approaches the non-verticillate, swollen-tailed Australian *Oedura* (*lesseurii*, *marmorata*, *rhombifera*, and *robusta* examined), for to the unaided eye the verticils of *pondolia* are indistinct.

Description: Digits free, moderate, dilated throughout, with raised distal joint bearing a slightly larger discoid dilation at apex, covered above with scales, not denticulate laterally, below on basal portion by scales or transversely dilated lamellae and one to two pairs of scansors slightly separated from another pair on the distal dilation, clawed, the claw retractile between the distal scansors.

Range: Africa south of the Cuanza River (i.e., 8° south latitude) in the west, and the Zambezi (i.e., 15° south latitude) in the east.

Afroedura karroica bogerti, new subspecies

Holotype: A.M.N.H. No. 47841, an adult male from Namba (Mombolo), Cuanza Sul Province, Angola, collected by Harry and Allan Chapman, between September and November, 1925.

Diagnosis: Mostly nearly related to *A. k. halli* (Hewitt) of the Orange Free State, Basutoland, and Cape Province north of 32° south latitude, whose nearest record is about 1500 miles distant from Namba. From *A. k. halli* and *A. k. karroica* (Hewitt), with which I would synonymize *A. k. wilmoti* (Hewitt), the new race may be distinguished as follows:

1. Nasals in contact behind rostral; male with four (? six to seven) preanal pores; tail strongly depressed, oval in section with angular lateral

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[1] Museum of Comparative Zoölogy, Harvard College.

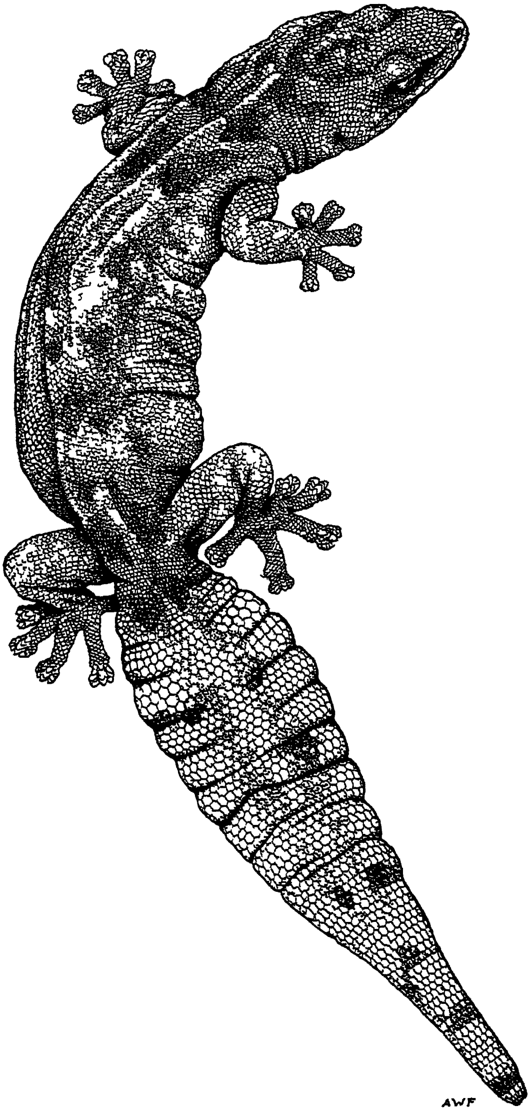

Fig. 1. *Afroedura karroica bogerti*, new subspecies. Male type (A.M.N.H. No. 47841, x 2) from Namba, Angola. (Too many granules are indicated between the supranasals. Actually only a single large granule separates these scales.)

edges; range: mountains of south-central Cape Province, south of 32° south latitude *k. karroica*

Nasals separated by a granule; male with eight preanal pores; tail depressed but thicker and with broadly rounded edges; range: north of 32° south latitude 2

2. Dorsal granulation finer (granules and ventrals round midbody number about 90); greatest width of tail 20 per cent the length of head and body, the tail width (6 mm.) being included 1.5 times in the width of the body (9 mm.); range: mountains of eastern Cape Province, Basuto-

land, and Orange Free State, north of 32° south latitude.......*k. halli*
Dorsal granulation coarser (granules and ventrals round midbody number about 75); greatest width of tail 13 per cent the length of head and body, the tail width (10 mm.) being included 1.3 times in the width of the body (13 mm.); range: east-central Angola.......*k. bogerti*

Description: Nostril between first labial and three nasals, the anterior largest and separated from its fellow by a single granule; both upper and lower labials eight; tail strongly segmented, each caudal verticil composed of five scales above and four below: male with eight preanal pores forming a slightly angular series. In other respects in agreement with the typical form.

Color: Above, grayish; back with five or six obsolescent, irregularly W-shaped brown crossbars; limbs and tail immaculate. Below, whitish, uniform. Apparently a very old gecko; in young specimens of this genus there is a more sharply defined pattern.

Size: Length of head and body, 50 mm.; length of tail, 42+ mm., the tip being missing; greatest width of tail, 10 mm.

Remarks: For comparative purposes only, a male *k. halli* and four females *k. karroica* (paratypes of *k. wilmoti*) are available; however, in other species of the genus where both sexes are represented, no sexual dimorphism as regards tail proportions is to be seen.

Pachydactylus scutatus angolensis, new subspecies

Holotype: A.M.N.H. No. 47874, an adult male from Hanha, Benguela Province, Angola, collected by Arthur Vernay, Herbert Lang, and Rudyerd Boulton, May 17, 1925.

Paratypes: A.M.N.H. No. 47872, a gravid female from Lobito Bay, Angola, collected by Herbert Lang, April 24, 1925, and Museum of Comparative Zoölogy, No. 46856, a male with same data as type, but collected May 13, 1925.

Diagnosis: Most nearly related to *P. s. scutatus* Hewitt, which that author considered allied to *P. montanus* Methuen and Hewitt, but which appears to be, in reality, a further development of the scaly-backed *P. p. punctatus* Peters. In *P. s. scutatus* the keeled scales covering almost the entire back are called tubercles by FitzSimons in his description of *robertsi*, here relegated to subspecific rank. Either designation is equally applicable, for within this genus the gradations from granule to scale and from scale to tubercle almost defy distinctive definition.

From its nearest allies the new race may be distinguished as follows:

1. Rostral, as well as first labial and three scales, bordering the nostril; range: Damaraland, South-West Africa.................*s. scutatus*
   Rostral excluded from bordering the nostril.
2. First labial and three scales bordering the nostril; range: Great Namaqualand, South-West Africa.......
   ....*s. robertsi*
   First labial excluded from bordering the nostril which is surrounded by three scales only; range: Benguela Province, Angola......*s. angolensis*

Description: Snout acuminate, slightly convex; ear-opening moderate, subcircular or vertically or horizontally oval; granules on snout flattened, smooth, much larger than those on occiput, which are intermixed with a few enlarged tubercles; mental as broad as, or slightly narrower than, adjacent labials; gulars minute, granular, juxtaposed.

Back, except for a narrow vertebral strip where the scales are small, almost entirely covered with large, strongly keeled, juxtaposed or imbricate scales (tubercles) among which occasional smaller ones may be scattered; flanks with smaller keeled scales; ventral scales smaller than dorsal, those in middle subequal to those toward sides, imbricate; limbs short, the adpressed hind limb reaching the wrist; digits long, slender, scarcely more strongly dilated at apex than at base, inferiorly with subdigital scansors, four (three to four in paratypes) under the first toe, five under the fourth, followed by transversely enlarged lamellae, five under the first toe, nine (eight to ten in paratypes) under the fourth; tail subcylindrical, tapering, covered above with small, smooth, or obtusely keeled scales, below with irregular, smooth, imbricate scales of which the median series is distinctly enlarged; on either side of base of tail in both sexes is a row of three white, flattened, pointed tubercles, with a smaller one below; tail at least as long as head and body.

COLOR: Above, grayish to reddish brown; a dark brown streak from nostril passes through eye to above ear-opening; crown of head almost uniformly pale; limbs more or less uniform; back with scattered white spots (which tend to form narrow transverse lines in one paratype); tail uniformly pale gray. Below, whitish, uniform.

SIZE: Length of head and body in male type, 35 mm.; length of tail, 33+ mm., being incomplete. Length of head and body in female paratype, 42 mm., tail missing.

REMARKS: Within the genus *Pachydactylus* the character cited in the diagnosis is unstable in some members of the genus, stable in others. As it holds for all three Angolan geckos, I prefer not to cite other minor differences which may prove inconstant when series of *s. scutatus* (described from an adult and juvenile) and *s. robertsi* (known only from the holotype) become available.

In view of the variability displayed by the three *s. angolensis* in which the dorsum may be covered exclusively by large keeled scales (apart from the narrow vertebral strip) or with a few small, scattered scales and granules interspersed among the larger ones, I do not think specific importance can be attached to the fact that there were none in *s. scutatus* and only a very few in *s. robertsi*.

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NEW PHALANGIDS FROM THE OLD WORLD

By Clarence J. and Marie L. Goodnight[1]

A few undescribed species of Phalangida from the Old World were encountered by the authors during their studies of the collections of the American Museum of Natural History. Although these animals are from widely separated areas, it was thought best to include them in a single paper.

All holotypes of these new species are deposited in the collection of the American Museum of Natural History.

SUBORDER LANIATORES THORELL

ASSAMIIDAE Soerensen

Polycoryphinae Roewer

PARAKODAIKA, NEW GENUS

Dorsum with five distinct areas, all dorsal areas and free tergites without median armature. Area I with a median line. Eye tubercle in the form of a rounded cone, unbedecked, slightly separated from the anterior median margin of the cephalothorax. Femur of the palpus without a median apical spine. Tarsal segments: 4-more than 6-4-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments.

GENOTYPE: *Parakodaika angolae*, new species.

Parakodaika is related to *Kodaika* Roewer; however, it has a median line in area I of the dorsum, and the tarsal segments are 4-more than 6-4-6, rather than 4-more than 6-5-6.

Parakodaika angolae, new species

Figures 8–12

MALE: Total length of body, 3.4 mm. Cephalothorax, 1.3 mm. Width of body at widest portion, 2.0 mm.

Dorsum with five distinct areas. Area I with a median line. Areas I to V and free tergites without median armature. Surface of the dorsal scute with fine granulations. Each dorsal area with irregular rows of granulations, which are more nearly regular on area V. Each free tergite with a transverse row of spinose tubercles, additional tubercles on the third free tergite. Eye tubercle slightly removed from the anterior margin of the cephalothorax, rounded, thickly covered with tuberculations, eyes at the base, several larger tubercles at the apex. Cephalothorax finely granulate, with scattered tuberculations just posterior to the eye tubercle and smaller ones scattered throughout. Projecting teeth underneath the anterior margin of the cephalothorax number: 2:1:2. The median tooth very small and hidden by the curved heavy spine of the cephalothorax; the median tooth of the lateral pair is the larger. The heavy

	I	II
Trochanter	0.4 mm.	0.4 mm.
Femur	1.6	2.2
Patella	0.5	0.5
Tibia	1.0	1.9
Metatarsus	1.5	2.4
Tarsus	0.7	1.5
Total	5.7 mm.	8.9 mm.

	III	IV
Trochanter	0.4 mm.	0.3 mm.
Femur	1.6	2.2
Patella	0.5	0.5
Tibia	1.3	1.6
Metatarsus	1.8	2.3
Tarsus	0.9	1.2
Total	6.5 mm.	8.1 mm.

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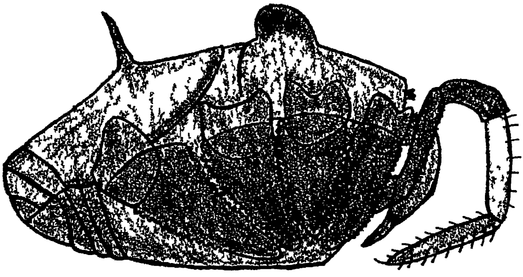
[1] University of Illinois, Urbana, Illinois.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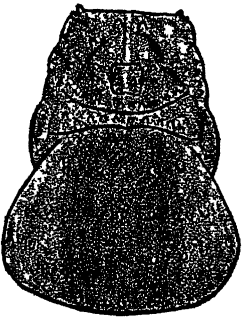
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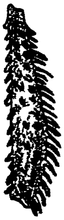
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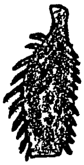
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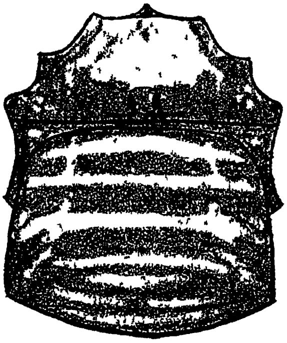
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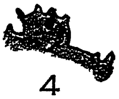
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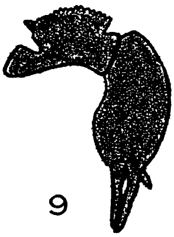
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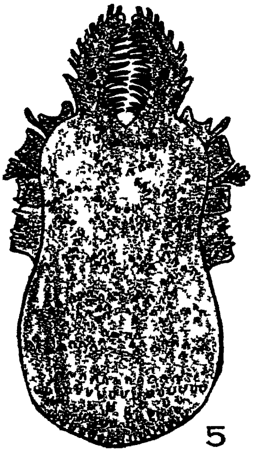
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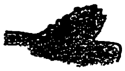
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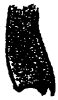
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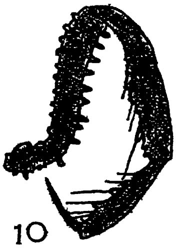
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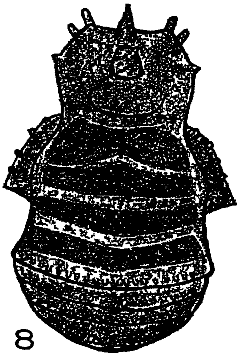
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Fig. 1. *Gagrellula indigena*, new species, lateral view of male.
Fig. 2. *Nelima morova*, new species, dorsal view of male.
Fig. 3. *Novabunus spinosus*, new species, dorsal view of male.
Fig. 4. Idem, lateral view of eye tubercle.
Fig. 5. *Dicranalasma napoli*, new species, dorsal view of male.
Fig. 6. Idem, fourth femur of male.
Fig. 7. Idem, first femur of male.
Fig. 8. *Parakodaika angolae*, new species, dorsal view of male.
Fig. 9 Idem, lateral view of chelicera of male.
Fig. 10 Idem, retrolateral view of palpus of male
Fig. 11. Idem, lateral view of eye tubercle of male.
Fig. 12 Idem, dorsal view of distal portion of femur of palpus of male

spine of the cephalothorax is located in front of the eye tubercle and curves strongly over the anterior margin; it bends ventrally between the chelicerae. Genital operculum roughly tuberculate. A transverse row of fine tubercles across each free sternite. Stigmen hidden by a group of thickly placed tubercular projections. Anal operculum granulate. Coxae granulate. Lateral teeth present on the anterior and posterior margins of coxa III; large tuberculations present on the entire anterior margin of coxa I, the distal posterior margin of coxa II, and both the anterior and posterior margins of coxa IV. Coxa IV widened.

Legs: granulate, femur IV slightly curved, a few scattered hairs throughout. Double claws of third and fourth tarsi simple. Third and fourth tarsi without a false claw. Tarsal segments: 4-8-4-6. Distitarsus of first tarsus with 2 segments; of second, 3 segments.

Palpus: trochanter, 0.4 mm. long; femur, 1.0; patella, 0.5; tibia, 0.6; and tarsus, 0.5. Total length, 3.0 mm. Palpus armed retrolaterally as in figure 10; prolaterally: femur and patella unarmed except for a somewhat larger spinous tubercle at the median apical portion of the femur (fig. 12). This scarcely appears to be a truly median apical spine; tibia and tarsus armed similarly to the retrolateral surface except for an extra spine-bearing tubercle on the tibia.

Chelicera: enlarged as in figure 9. Median immovable claw with a hook at the proximal portion. Movable claw with a large median tooth.

Entire animal reddish yellow, distal portion of appendages and venter somewhat lighter.

Type Locality: Holotype from Chitau, Angola, August 13, 1925 (H. Lang and R. Boulton).

SUBORDER PALPATORES THORELL

Tribe **DYSPNOI** Hansen and Soerensen

TROGULIDAE Simon

Dicranalasma napoli, new species

Figures 5–7

Male: Total length of body, 2.7 mm. Cephalothorax, 0.7 mm. Width of body at widest portion, 1.7 mm.

	I	II
Trochanter	0.3 mm.	0.4 mm.
Femur	0.9	1.9
Patella	0.5	0.5
Tibia	0.5	0.5
Metatarsus	0.7	0.7
Tarsus	0.4	0.4
Total	3.3 mm.	4.4 mm.

	III	IV
Trochanter	0.4 mm.	0.4 mm.
Femur	0.8	1.3
Patella	0.5	0.4
Tibia	0.6	0.9
Metatarsus	1.0	1.6
Tarsus	0.4	0.5
Total	3.7 mm.	5.1 mm.

Dorsum roughly granulate, with numerous obtuse spines. These spinose projections are more numerous on the abdomen; more or less arranged in an irregular pattern on the cephalothorax. Posterior portion of the abdomen with transverse rows of slightly longer projections. Eye tubercle characteristically prolonged into two projections; each of these projections is strongly curved and somewhat widened in the median portion. Eyes carried forward to the median portion of the projection. Each lateral margin of the eye projection with a row of spines. These spines much longer on the prolateral margin. Entire eye tubercle roughly granulate. A single, blunt, club-like projection at each anterior lateral margin of the cephalothorax. Venter finely granulate, coxae very roughly granulate. Anterior portion of first coxa with numerous spinose projections. Anterior lateral margin of coxa IV with long projections; posterior distal portion of coxa II with eight or ten projections in a group. Dorsally the distal portion of coxa I has a short projection.

Legs: roughly granulate, with lateral

rows of large spine-like projections. Femur II with projections reduced, femora I and III heavier and shortened. Tarsal segments: 4-4-4-4. Distitarsus of first tarsus with 1 segment; of second, 1 segment. Ultimate segment of second tarsus characteristically elongate.

Palpus: trochanter, 0.1 mm. long; femur, 0.4; patella, 0.3; tibia, 0.4; and tarsus, 0.3. Total length, 1.5 mm. Palpus characteristic, clothed throughout with hairs.

Chelicera: normal, claw strongly curved.

Entire animal yellowish brown, some darker mottlings present.

TYPE LOCALITY: Holotype from Naples, Italy.

This species differs from other members of the genus in the arrangement of the dorsal spines and in the number of tarsal segments.

Tribe **EUPNOI** Hansen and Soerensen

PHALANGIIDAE Simon

Leiobuninae Banks

Nelima morova, new species

Figure 2

MALE: Total length of body, 3.8 mm. Cephalothorax, 1.5 mm. Width of body at widest portion, 3.5 mm. Length of femora: I, 11.4 mm.; II, 17.5 mm.; III, 10.5 mm.; IV, 15.0 mm.

Dorsum smooth, eye tubercle slightly canaliculate, smooth above, located towards the posterior portion of the cephalothorax, somewhat slanted posteriorly. Supracheliceral lamella in the form of an expanded plate. Venter finely granulate. Coxae roughly granulate, without lateral teeth.

Legs: with a few small scattered hairs, without nodules. Metatarsi with false articulations.

Palpus: trochanter, 0.3 mm. long; femur, 1.6; patella, 0.5; tibia, 0.9; and tarsus, 1.8. Total length, 5.1 mm. Palpus clothed throughout with hairs, a few small, spine-like hairs on the ventral portion of the femur. Patella without apophyses. Tarsal claw toothed.

Chelicera: normal.

Dorsum dark brown, with a series of transverse yellowish stripes. Anterior portion of cephalothorax with a large light spot. Eye tubercle light at base and in the median dorsal portion; dark around the eyes. A few lighter spots scattered irregularly over the lateral portions of the cephalothorax. Venter and coxae yellowish. Trochanters and bases of femora dark brown, contrasting. Remainder of legs reddish brown with a light portion at the distal portion of each segment but the patellae. This lighter portion is sometimes absent, is quite variable. Chelicerae and palpi reddish brown. Tips of cheliceral claws dark.

TYPE LOCALITY: Male holotype from Misaki, Japan (north Yatsu).

This species is related to *N. nigracoxa* Sato and Suzuki, differing by having the coxae yellowish rather than black.

Phalangiinae Simon

NOVABUNUS, NEW GENUS

Eye tubercle spinose, chelicera not abnormally enlarged. No median dorsal spines. The anterior median portion of the cephalothorax with two spines.

GENOTYPE: *Novabunus spinosus*, new species.

Novabunus is related to *Diabunus* Thorell, but differs by having a spinose eye tubercle.

Novabunus spinosus, new species

Figures 3 and 4

MALE: Total length of body, 3.9 mm. Cephalothorax, 1.6 mm. Width of body at widest portion, 2.9 mm.

	I	II
Trochanter	0 5 mm.	0.4 mm.
Femur	1.9	3.0
Patella	1.0	0.9
Tibia	1 8	2.7
Metatarsus	2.0	2.0
Tarsus	2 7	—
Total	9.9 mm.	—

	III	IV
Trochanter	0.4 mm.	0.6 mm.
Femur	1.8	2.7
Patella	0.9	1.0
Tibia	1.2	2.4
Metatarsus	2.5	2.4
Tarsus	3.4	4.5
Total	10.2 mm.	13.6 mm.

Dorsum finely granulate, with a transverse row of small spines across the first four abdominal segments. Smaller scattered spines, which are not arranged in as definite rows, on the posterior abdominal segments. Cephalothorax with numerous scattered small spines. Two transverse rows of spines posterior to the eye tubercle. A thicker group of spines just laterad to the eye tubercle on either side. Anterior median portion of the cephalothorax with two distinctly larger spines. Eye tubercle at the posterior portion of the cephalothorax, slightly canaliculate, a row of four to five spines over each eye, posterior spine the largest. Venter and coxae with scattered spine-like hairs. Coxae without lateral teeth. Maxillar lobes of coxa II slanted.

Legs: Femora, patellae, and tibiae of legs somewhat enlarged, basal portions of legs I and III heavier than those of II and IV. Leg IV heavier than II. Femora with rows of small spines, giving an angular appearance. All remaining segments of legs with scattered hairs. Patellae and tibiae with rows of small tubercles which give an angular appearance. Metatarsi with some false articulations.

Palpus: trochanter, 0.5 mm. long; femur, 1.1; patella, 0.6; tibia, 0.6; and tarsus, 1.3. Total length, 4.1 mm. Palpus clothed throughout with hairs; black spine-like hairs on all segments but the tarsus. Tarsal claw smooth.

Chelicera: with scattered hairs, a group of small spines on the distal dorsal portion of the proximal segment. Proximal segment without a ventral spine, distal segment with a slight dorsal elevation.

Dorsum dark brown, with lighter mottlings. Some specimens are considerably lighter, having an indefinite darker broad median stripe. Eye tubercle dark, with a median light line. Venter and coxae concolorous with the dorsum, varying from dark to light brown. Trochanters of legs lighter brown. Legs brown, lighter distally. Chelicera and palpus brown, varying from light to dark. In some specimens the dorsal spines are lighter.

Female: Total length of body, 7.0 mm. Cephalothorax, 2.0 mm. Width of body at widest portion, 4.3 mm.

Female similar in appearance to male. Spines somewhat reduced, lacking the slight cheliceral elevation.

Type Locality: Male holotype and male and female paratypes from Abyssinia, November 25, 1920 (B. Brown).

Gagrellinae Thorell

Gagrellula indigena, new species

Figure 1

Male: Total length of body, 3.6 mm. Cephalothorax, 1.1 mm. Width of body at widest portion, 2.4 mm. Length of femora: I, 7.7 mm.; II, 12.3 mm.; III, 8.0 mm.; IV, 10.8 mm.

Dorsum roughly granulate; eye tubercle towards the posterior portion of the cephalothorax, canaliculate, smooth above except for a few small hairs. Supracheliceral lamella in the form of two projections, with several spinules at the distal portion. The posterior portion of the second segment of the dorsum with a long median spine. This spine is slender, pointed, and in some specimens slightly curved. Venter and coxae roughly granulate, granulations particularly heavy on the coxae. Lateral teeth well developed on the anterior and posterior margins of all coxae. Teeth 3-pronged, but the prongs are much reduced in size, tending to give a flat appearance to the teeth.

Legs: all segments but metatarsi and tarsi armed with small black spines, which are more or less arranged in rows. Metatarsi and tarsi clothed only with hairs. Metatarsi with false articulations. Nodules of femora: 0-3-0-0.

Palpus: trochanter, 0.3 mm. long; femur, 1.0; patella, 0.4; tibia, 0.8; and tarsus, 1.0. Total length, 3.5 mm. Palpus clothed throughout with hairs. All segments but the tarsus with small spines.

Ventral portion of femur thickly armed with black-tipped spines. Patella without apophyses.

Chelicera: normal, smooth, first segment with only a few very fine tubercles.

Dorsum reddish to dark brown. In the lighter colored specimens there is a darker brown margin around the cephalothorax and abdominal scute. Dorsal spine dark brown, eye tubercle dark, lighter at base. Venter, coxae, and trochanters dark brown. Legs somewhat lighter. Femur and patella of palpus dark brown. Tibia and tarsus lighter. Chelicera light brown with dark blotches.

TYPE LOCALITY: Male holotype and paratypes from Szechwan Province, China (W. Granger). Male paratype in the collection of the Chicago Natural History Museum.

This species is related to *G. unicolor* Roewer, but differs in the dorsal coloration, length of legs, and the lateral teeth of the coxae. In *G. unicolor* the teeth are 4-pronged, but in *G. indigena* they are only 3-pronged and very much flattened.

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NOTES AND DESCRIPTIONS OF SOME AMERICAN EROTYLIDAE

BY C. H. CURRAN

During study of the Erotylidae in the Museum collection it has become apparent that there are many undescribed species in the family, and that a goodly number of the described forms are only color phases of valid species. For the most part the erotylids are very attractive insects, and the colors and patterns are rather striking. Unfortunately, there is a great deal of variation in the color pattern, and two extremes in coloration of the same species would seem to indicate two distinct forms. However, when large series are available it becomes a simple matter to bring these extremes together through the natural variation in the color pattern, and it is then possible to see that, though the extremes vary greatly, they actually conform to the general pattern of the species. In addition to variation in the pattern, there is also great variation in the color. Species that have a reddish pattern when mature very often have it yellowish when newly emerged. This has resulted in the description of mature and teneral forms as distinct species.

This contribution contains a review of the genus *Oocyanus* Hope and a new genus which I am calling *Erotylina*. It is most unfortunate that the long-established name *Megalodacne* Crotch must be replaced by *Zonarius*, while *Zonarius*, as now used, must be replaced by *Alloiotelus* Hope.

The illustrations have been prepared by Mrs. A. W. Froderstrom. They depict the typical form, but in a few cases extremes have been included.

OOCYANUS HOPE

Oocyanus HOPE, 1841, Rev. Zool., p. 113.

Oocyanus LACORDAIRE, 1842, Monogr. Erotylidae, p. 194.

Epytus DEJEAN, 1837, Cat. Coleopt., ed. 3, p. 452.

Elongate species, about two and one-half times as long as wide, usually tapering posteriorly from the humeri, the wing covers with seven or eight rows of punctures. The club of the antennae is pale yellowish, rarely reddish, and the tarsi are always yellowish. The apical segment of both the labial and maxillary palpi are equally enlarged. The size ranges between 6 mm. and 10 mm.

GENOTYPE: *O. cyaneus* Duponchel.

Dejean, in both the second and third editions of his "Catalogue of Coleoptera," listed *violaceus* Lacordaire and *cyaneus* Duponchel as synonyms of *azureus* Dejean, placing them under the generic name *Epytus*. This is the only use of the name *Epytus*, and it is, therefore, unavailable. The name *cyaneus*, although proposed two years before *violaceus*, has been placed as a synonym of the latter.

Up to the present time *Oocyanus* is known only from the West Indies, and all of the described West Indian species of *Ischyrus* Lacordaire belong to *Oocyanus*. However, I have seen an undescribed species of *Ischyrus* from the region.

As in other genera, the color pattern of the bicolored species is quite variable, and extremes in color variation look quite different. But if the general scheme of the pattern is considered it is at once obvious that these extremes conform to the general pattern, and they may be properly associated specifically even though typical forms are not available.

Illustrations of the six species in the Museum collection are given and, in connection with the key, should make the determination of the species quite simple.

TABLE OF SPECIES

1. Pronotum wholly black, the femora black or brown except in teneral specimens (in these the basal half

of the tibiae is darker than the apical half)............................2
Pronotum normally partly reddish or yellowish, if practically all black the apical half of the femora and the tibiae reddish................... 4
2. Elytra with sub-basal and preapical yellowish or reddish fasciae (Dominica).............*modestus* Olivier
Elytra uniformly colored, sometimes obscurely reddish apically (Cuba)..3
3. With steel-blue or violaceous tinge; antennae reddish yellow, the club yellow (Cuba)...*cyaneus* Duponchel
Black with more or less greenish sheen (Cuba)... .....*tarsalis* Lacordaire
4. Prothorax reddish with basal and apical black markings...............5
Prothorax black with broad lateral and sometimes median reddish vittae...6
5. The basal incomplete black band on the pronotum has four broad, anteriorly directed lobes (Cuba, Bahamas, Haiti, Dominica)........... ....*flavitarsis* Lacordaire
The incomplete basal and apical black bands, which vary in width, project toward each other laterally and may be obsolete in the middle (Haiti).. .... *haitensis*, new species
6. Pronotum very broadly reddish only on the anterior half of the sides (Dominica, Haiti)................ ....*fulvitarsis* Lacordaire
Pronotum very broadly reddish laterally on the whole length; normally a broad median reddish vitta (Dominica)............*fulvitarsis* variety

Oocyanus haitensis, new species

Figure 1

Black with extensive reddish markings, the pronotum reddish with black base and apex. Length, 8 to 9.25 mm.

Head black, the palpi and apical two antennal segments reddish yellow, the antennae castaneous with the basal two segments and the nodes reddish. Front rather finely and thickly punctured. Pronotum reddish, the median three-fifths of the base and half of the apex black, expanded laterally, the surface with numerous fine punctures. Under side of thorax blackish, the sides of the prothorax very broadly reddish except posteriorly, the middle sometimes more or less reddish. Abdomen reddish, the first segment black. Legs black or brown, the tarsi reddish. Elytra black, with a broad to very broad reddish fascia at the basal fourth that is broadly interrupted at the suture, a usually narrower reddish band at the apical third, narrowly interrupted at the suture, and the reddish apex very broadly connected laterally with the preceding band but sometimes only narrowly so. The epipleura are reddish except on the broad base. Elytra with eight weak striae and seven rows of weak punctures, the eighth stria without punctures.

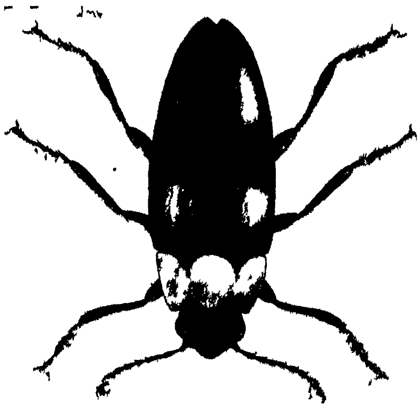

Fig. 1. *Oocyanus haitensis.*

In the single female, the basal and subapical reddish fasciae are broadly united on the middle of each elytron, but the black fascia is indicated by slightly darker ground color. This is an extreme in coloration that probably occurs in both sexes.

TYPES: Holotype, male, allotype, female, and one male paratype, Northeast Foothills, La Hotte, Haiti, 2000 to 4000 feet, October 10-24, 1934; one male, Tardieu, La Hotte, Haiti, 3000 feet, November 14, 1934, all collected by P. J. Darlington.

The only other known species having a reddish pronotum is *flavitarsis* Lacordaire, but it is at once distinguished by the four broad black projections on its base. The color in *flavitarsis* is usually reddish yellow. The sides of the pronotum in *haitensis* are generally very narrowly black on about the posterior third.

Oocyanus flavitarsis Lacordaire

Figure 2

Ischyrus flavitarsis LACORDAIRE, 1842, Monogr. Erotylidae, p. 130.

This species is easily recognized by the color of the pronotum. The elytra have an orange or reddish interrupted fascia at the basal third and a broad one at the apical fourth. The legs are black or brown with reddish or yellowish tarsi, the antennae blackish with the apical segment reddish or yellowish.

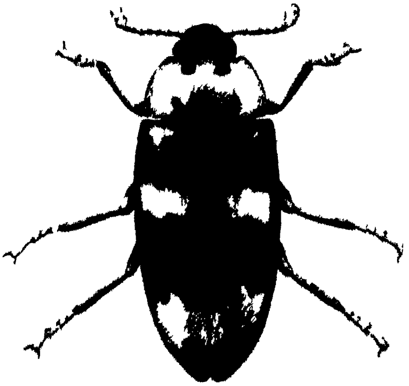

Fig. 2. *Oocyanus flavitarsis.*

I have seen specimens from Cuba, Haiti, Dominican Republic, and the Bahamas.

Oocyanus modestus Olivier

Figure 3

Ischyrus modestus OLIVIER, 1791, Ent., vol. 5, p. 483 (f.).

Ischyrus modestus LACORDAIRE, 1842, Monogr. Erotylidae, p. 130.

Similar to the preceding species but with the mesonotum wholly black.

The material before me is all from the Dominican Republic; all but one specimen collected by P. J. Darlington.

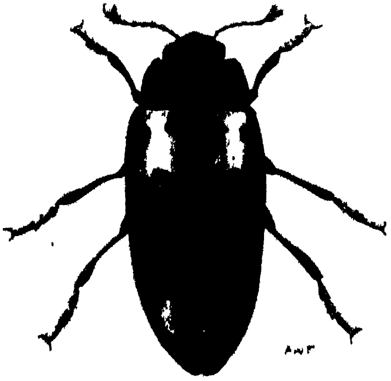

Fig. 3. *Oocyanus modestus.*

Oocyanus fulvitarsis Lacordaire

Figures 4, 5

Ischyrus fulvitarsis LACORDAIRE, 1842, Monogr. Erotylidae, p. 129.

Oocyanus brunnipes KUHNT, 1910, Deutsche Ent. Zeitschr., p. 231.

Black with reddish markings. The legs are reddish, the base of the middle femora usually broadly darker, sometimes brown. In the typical form the pronotum is broadly reddish on the sides on the anterior half, the under side broadly reddish on almost the whole length. The elytra have a broad reddish fascia just behind the basal fourth, well separated from the suture,

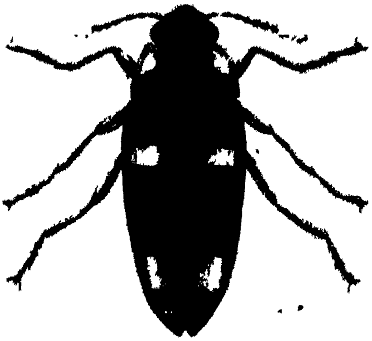

Fig. 4. *Oocyanus fulvitarsis.*

another at the apical fourth, and the apex broadly reddish, the posterior fascia sometimes connected laterally with the apical spot which is strongly convex in front. The antennae vary in color from reddish to ferruginous with the two apical segments reddish yellow.

In the variety the chief difference is found in the color of the thorax. In this form the sides of the pronotum are broadly reddish on practically the whole length of the upper surface, and there is an incomplete median reddish vitta that is broadened in the middle, rather spindle-shaped, but variable in length and width.

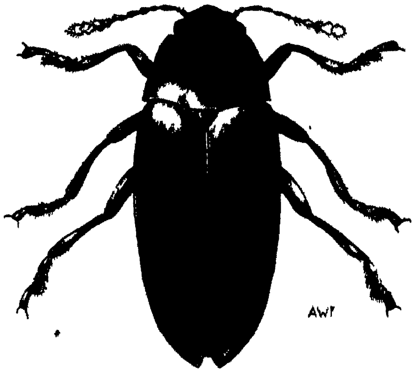

Fig. 5. *Oocyanus fulvitarsis*, dark form.

In both forms the anterior reddish fascia on the elytra is very variable. It may be broad or narrow and may sometimes be divided in the middle, or partly so, and may sometimes be absent.

The series before me does not contain any perfect connecting forms of the two varieties, although some specimens of the typical form show indications of the median vitta on the pronotum. However, in view of the great variation in color that occurs in many of the species of this family, it seems certain that connecting forms will be found in abundance, and for this reason I do not consider that varietal names should be employed. I can find no structural characters to separate the two.

O. brunnipes Kuhnt is nothing more than a dark form of this species, and examples before me agree perfectly with the description. The reddish markings on the thorax are only faintly indicated, the sub-basal elytral band is wholly absent, and the reddish apical spots are reduced and darkened. Both legs and antennae are reddish brown. The reduction of the color pattern is shown in the series in the collection.

This species was originally described from Haiti, but all my material (more than 30 specimens) is from the Republic of Dominica, collected by P. J. Darlington.

Oocyanus tarsalis Lacordaire

Figure 6

Ischyrus tarsalis LACORDAIRE, 1842, Monogr. Erotylidae, p. 106.

Oocyanus tarsatus LACORDAIRE, 1842, *op. cit.*, p. 196.

Black with slight greenish reflection, the tarsi pale orange or yellow, the apical three antennal segments yellow.

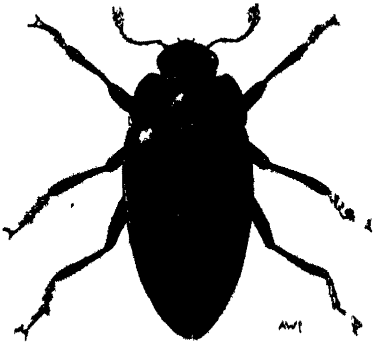

Fig. 6. *Oocyanus tarsalis*.

A very distinct species, originally described from Haiti. Mr. Darlington secured a dozen or more specimens in Cuba.

O. tarsatus of Lacordaire was described from Colombia, but the locality should be considered erroneous. If the locality is correct, it is probable that a different species is concerned. However, no species of *Oocyanus* are known outside the West Indies, so there is good reason to believe that the locality given by Lacordaire was wrong.

Oocyanus cyaneus Duponchel

Figure 7

Ischyrus cyaneus Duponchel, 1821, Monogr. Gen. Erotylidae, p. 31 (f.).

Ischyrus violaceus Sturm, 1826, Cat., p. 82 (f.).

Oocyanus violaceus Lacordaire, 1842, Monogr. Erotylidae, p. 196.

Black, the dorsum more or less strongly violaceous, the tibiae and tarsi reddish yellow, the antennae reddish yellow with the apical three segments usually pale yellow.

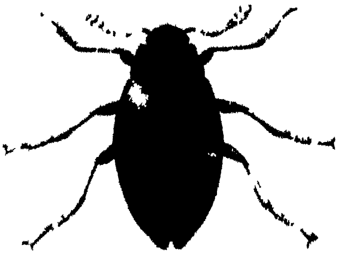

Fig. 7. *Oocyanus cyaneus.*

Known only from Cuba. The two specimens before me are from Guantanamo. This is the type of the genus and is easily recognized by its color.

ZONARIUS Hope

Zonarius Hope, 1841, Rev. Zool., p. 111.

Megalodacne Crotch, 1873, Trans. Amer. Ent. Soc., vol. 4, p. 352.

This name has been incorrectly applied since 1842, when Lacordaire applied the name to the group to which Hope had given the name *Alloiotelus*. Hope named *Helops fasciatus* Fabricius the type of *Zonarius*, but Lacordaire considered it to be a *Helops* and at the same time included it in the genus *Dacne* Latreille. The action of Hope is quite clear, and it is, therefore, necessary to alter our conception of the genera which have been known for so long under the two names cited above. The name *Zonarius* should be inserted in existing catalogues of the Coleoptera in place of *Megalodacne*.

ALLOIOTELUS Hope

Alloiotelus Hope, 1841, Rev. Zool., p. 112.

Zonarius Lacordaire, 1842, Monogr. Erotylidae, p. 468; Chapuis, 1876, *in* Lacordaire, Gen. Coleoptera, p. 61; Gorham, 1888, Biol. Centr. Amer., Coleoptera, vol. 7, p. 109; Kuhnt, 1910, Deutsche Ent. Zeitschr., p. 251; Kuhnt, 1911, *in* Junk, Cat. Coleoptera, vol. 15, pt. 34.

Fortunately it is not necessary to propose a new name for the species placed in *Zonarius* since 1842. *Alloiotelus* will replace *Zonarius* in existing catalogues. All the known species occur in tropical America.

EROTYLINA, NEW GENUS

Differs from *Erotylus* in having the tibiae convex above and entirely lacking the three strong longitudinal carinae (see fig. 8). All the species are elongate, about twice as long as wide, and all have three or more depressions on the upper surface of the prothorax.

Fig. 8. A, Lateral view of tibia of *Erotylus;* B, dorsal view of tibia of *Erotylus;* C, dorsal view of tibia of *Erotylina;* D, lateral view of tibia of *Erotylina.*

Genotype: *Erotylus leopardus* Lacordaire.

I have selected *leopardus* Lacordaire as the type because of the confusion surrounding the identity of *pustulatus* Duponchel. *E. leopardus* is fairly well represented in collections and, although it varies considerably in color, the species is easily recognized.

Erotylina apparently includes all the species in group 8 of Kuhnt ("Genera insectorum," fasc. 88), some species from group 6 Kuhnt, and possibly some from other groups. The identification of the described species is quite difficult, and it seems likely that a number of the names apply to color varieties. This, however, can only be determined by comparison of large series.

The following key separates the species before me:

Table of Species

1. Legs wholly black..................8
   Femora mostly reddish.............2
2. Thorax black with yellow border (not seen)................*rufipes* Crotch
   Thorax reddish or yellowish, with black spots...........................3
3. Apex of tibiae broadly reddish........4
   Tibiae wholly blackish..............5
4. Elytra reddish to castaneous, with numerous irregular black spots, the lateral margins usually yellow...... ....*maculiventris* Lacordaire
   Elytra with large, reddish or reddish yellow round spots in more or less distinct lines, the lateral margin reddish..............*dura*, new species
5. Elytra reddish brown, with rather sparse yellow spots and yellow lateral margin.....*multiguttatus* Lacordaire
   Elytra black with numerous small pale spots...........................6
6. Middle tibiae with an incomplete posterodorsal carina.................. ....*nigrotibialis* Crotch
   Middle tibiae without trace of carina.7
7. Middle segment of antennal club longer than wide..*maculiventris* Lacordaire
   Middle segment of antennal club wider than long..*bardia*, new species
8. Elytra with the lateral margin wholly pale...........................9
   The black markings extend to the lateral margins.................13
9. Elytra with large round yellowish to orange spots that are usually more or less confluent, usually leaving two or three irregular black fasciae, sometimes the black reduced to irregular lines, rarely chiefly black with a few large reddish spots (Mexico)......*leopardus* Lacordaire
   Elytra with very numerous round reddish or yellowish spots (South America)......................10
10. Round spots of the elytra yellowish ....*intermedia* Crotch
    Round spots of the elytra red......11
11. The sixth and seventh rows of punctures begin near the humerus....12
    This double row of punctures begins behind the basal third of the elytron ....*connectens* Crotch
12. A very strong ridge extends back from the anterior coxae to the posterior edge of the mesosternum ....*brazilianus* Kuhnt
    The ridge extends only slightly beyond the coxal cavities................ ....*pustulatus* Duponchel
13. Elytra with round, more or less confluent reddish or yellowish spots.14
    Elytra with wide black or brown fasciae........................16
14. Scutellum reddish..*scutellatus* Kuhnt
    Scutellum black.................15
15. Almost always with a wide transverse black band near the middle of the elytra...........*vixen*, new species
    With at most very narrow, oblique black bands, the pale reddish spots forming rather regular lines....... ....*foveatus* Kuhnt
16. Prothorax almost twice as wide as long 17
    Prothorax almost as long as wide...19
17. Elytra luteous, the entire border and two irregular, interrupted, and incomplete fasciae brown........... ....*buquetii* Lacordaire
    Elytra orange and black..........18
18. Elytra with median black band and apex, the apex containing a small orange spot....*bassleri*, new species
    Elytra with broad median and preapical orange fasciae and two very large, sometimes confluent spots on each near the base............ ....*scita*, new species
19. Median yellow fascia linear......... ....*lacordairei* Lacordaire
    Median yellow fascia very broad..... ....*helopioides* Duponchel

Erotylina rufipes Crotch

Erotylus rufipes Crotch, 1876, Cist. Ent., vol. 1, p. 531.

I have not seen this species, but it may be readily recognized by the black, yellow-bordered prothorax. The elytra are reddish with numerous, irregular black spots. Colombia.

Erotylina maculiventris Lacordaire

Figure 9

Erotylus maculiventris Lacordaire, 1842, Monogr. Erotylidae, p. 444.

Varying in color from yellowish red to castaneous, the tarsi and the basal three-fourths of the tibiae black. In light-colored specimens the lateral margins of the elytra are yellow; in darker ones, luteous or reddish, the pale color sometimes visible only under magnification. The prothorax bears seven to eleven black spots, usually nine, but there is considerable variation in size and shape. In most of my Ecuadorean specimens there is a tendency toward formation of rows of pale spots, particularly along the suture, a tendency less well marked in the Peruvian material, and in some of the specimens many of the black spots are replaced by brown, castaneous, or dark reddish spots. The number of black spots varies enormously, and the pattern is extremely irregular. The elytral punctures are large, toward the suture in rows, otherwise irregularly placed and numerous; the rows are not paired. Length, 13 to 18 mm.

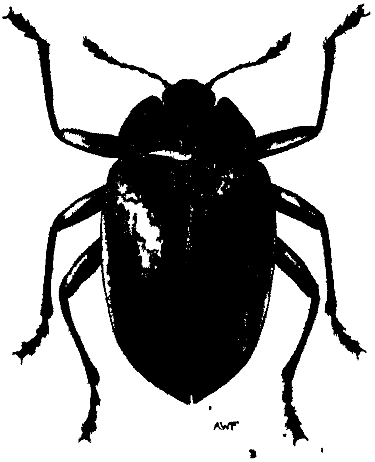

Fig. 9. *Erotylina maculiventris.*

Forty specimens from Panama, Ecuador, Peru, and Brazil. Originally described from Colombia.

Erotylina bardia, new species

Figure 10

Pale orange to brownish red, the sides of the elytra yellow. Length, 14 mm.

Antennae black, the subapical segment conspicuously wider than long, the two basal segments reddish. A pair of shallow depressions on the front between the eyes, and behind these a pair of more or less contiguous dark spots. Prothorax with 11 black or brown spots, some of which may be united or obsolete. Middle coxal line short but well marked. Femora reddish, the apices of the tibiae reddish brown, the tibiae and tarsi black. Elytra with black markings, leaving small yellowish or reddish spots that are more or less fused. The punctures are large, abundant, and irregularly distributed, but there are three or four lines of punctures toward the suture.

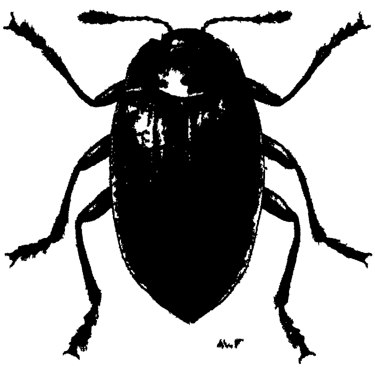

Fig. 10. *Erotylina bardia.*

Types: Two females, holotype and paratype, Rio Abujas, Peru, February, 1929 (H. Bassler).

This species is very similar to *maculiventris* but is a little less convex and distinctly less shining. Neither of the specimens have black spots on the abdomen, but since these are sometimes absent in *maculiventris* the character is of little value, and additional material may show that they may occur in *bardia*. The pale elytral spots are smaller and much more numerous than ordinarily found in *maculiventris* and more inclined to form longitudinal and transverse lines. The length of the preapical antennal segment appears to offer the best means of distinguishing the two species.

Erotylina dura, new species

Figure 11

Bright reddish, the elytra brownish red to black, with numerous roundish, reddish to pale reddish spots. Length, 11 to 16 mm.

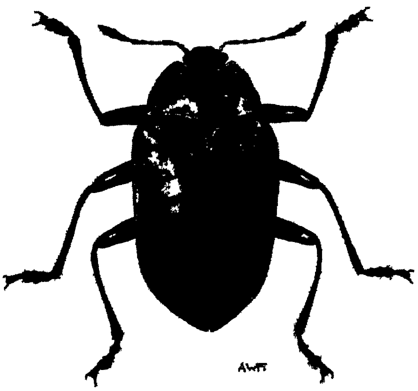

Fig. 11. *Erotylina dura.*

Head reddish, the clypeus, palpi, and basal two antennal segments reddish yellow; antennae blackish or brownish. Thorax with nine black spots above, a basal row of five and an anterior arched row of four, but there is some variation in the size and shape of the spots. Legs reddish, the tibiae black or brown with the apices broadly brownish red, the tarsi black or brown. The elytra are black, brownish, or castaneous with very numerous, moderately large, bright reddish or dark orange spots arranged in more or less regular rows, the lateral margin and epipleura wholly reddish. The punctures are large, in seven rows, the outer six paired, between the rows some scattered punctures, the rows becoming more or less confused posteriorly, and the scattered punctures usually more numerous in front of the middle and near the apical third; there is also a row inside the lateral margin.

In comparison with the other species having reddish femora, *dura* has the elytra more convex and more produced near the middle.

TYPES: Four males and three females from Teffe, Brazil (H. Bassler, and Thayer Expedition) and "Peru." The holotype is from Teffe, the allotype from "Peru." Paratypes in the Museum of Comparative Zoölogy.

Erotylina multiguttatus Lacordaire

Erotylus multiguttatus LACORDAIRE, 1842, Monogr. Erotylidae, p. 441.

A yellow species, the elytra pale brown with moderately numerous roundish yellow spots, the tibiae and tarsi black. The punctures are very large and numerous, the three or four lines near the suture arranged in rows. The middle tibiae have a posterodorsal carina. The prothorax has three rows of blackish spots, five in the basal row, and four in each of the others, but the outer spots in the median row are small and are, perhaps, sometimes absent.

One specimen, upper Rio Marañón, Peru, April 3, 1929 (H. Bassler). Originally described from Bolivia and recorded from Paraguay.

The identification is somewhat doubtful, since Lacordaire described the thorax as having numerous brown spots. The specimen agrees in other respects.

Erotylina nigrotibialis Crotch

Erotylus nigrotibialis CROTCH, 1876, Cist. Ent., vol. 1, p. 535.

This species agrees in almost all respects with the preceding one, but the color is reddish and the dorsal spots black and less extensive, so that the reddish spots run more or less together.

One specimen, middle Rio Ucayali, Peru, December 1, 1923 (H. Bassler).

I suspect that this specimen and the one placed under *multiguttatus* are color phases of the same species, but it is impossible to decide with the material at hand. They look very different, but since there is a great deal of variation in related species the possibility of their being the same must not be overlooked. There is little doubt about this being *nigrotibialis*, although the original description is very poor.

Erotylina leopardus Lacordaire

Figure 12

Erotylus leopardus LACORDAIRE, 1842, Monogr. Erotylidae, p. 442.

Erotylus confluens CROTCH, 1876, Cist. Ent., vol. 1, p. 531.

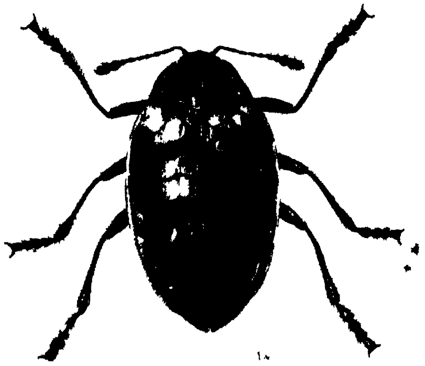

Fig. 12. *Erotylina leopardus.*

Black, the elytra black and dull reddish to yellow or reddish with black markings. The pale spots are large, more or less confluent, typically with three or four black fasciae, but any of the black bands may be obsolete, and sometimes there are only irregular transverse spots on reddish ground (*confluens*), but the lateral margin is always wholly pale. In one specimen from Jalapa, Mexico, the red is very greatly reduced, there being nine orange spots on one elytron and 11 on the other. At first glance it looks entirely different from *leopardus*, but it is only a very dark specimen. Length, 12 to 17 mm.

More than 40 specimens from Mexico, Guatemala, El Salvador, and Costa Rica.

Erotylina nicaraguae Crotch

Erotylus nicaraguae CROTCH, 1869, Cist. Ent., vol. 1, p. 148.

This species is similar to the variety *confluens* but is yellowish with the lateral margins of the elytra mostly reddish. I have not seen anything agreeing with the description but believe that it is merely a color variation of *leopardus*.

Erotylina connectens Crotch

Figure 13

Erotylus connectens CROTCH, 1876, Cist. Ent., vol. 1, p. 531.

Shining black, the elytra pale reddish with irregular black markings, leaving numerous, moderately small, subconfluent reddish spots, the epipleura wholly reddish. This form agrees very well with *pustulatus* Duponchel, but the reddish spots are slightly larger than is usual in that species, and the sixth and seventh rows of punctures begin behind the basal third of the elytra instead of near the humeri. The front tibiae of the male are scarcely swollen at the apex.

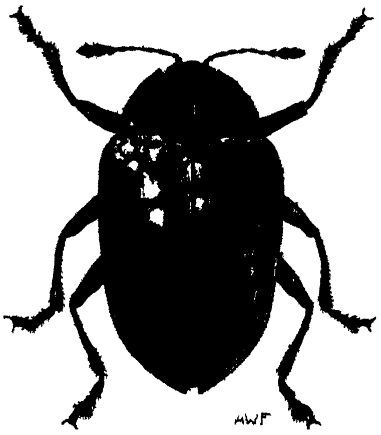

Fig. 13. *Erotylina connectens.*

One male, Rio Caiary Uaupes, Amazonas, Brazil, 1906 (H. Schmidt). Crotch described the species from Brazil, probably from the Amazon.

Erotylina intermedia Crotch

Erotylus intermedia CROTCH, 1876, Cist. Ent., vol. 1, p. 531.

Blackish brown, the head with a dark spot, the thorax with seven or nine darker spots; elytra yellow with black and brown markings, leaving moderately small semiconfluent round spots not forming rows.

Two specimens, Anapolis, Goyas, Brazil. Crotch described the species from Venezuela.

The pale spots are larger than is usual in *pustulatus*, but there is no other difference, and I believe that *intermedia* was based on a teneral specimen or one that had been in alcohol, as is true of the specimens before me. However, it is impossible to identify *intermedia* from the description, and my specimens may not be the same.

Erotylina pustulatus Duponchel

Erotylus pustulatus DUPONCHEL, 1824, Mem. Mus. Hist. Nat., Paris, vol. 12, p. 39, fig. 8.

Erotylus jaspideus ERICHSON, 1847, Arch. Naturgesch., vol. 13, p. 176; KUHNT, Genera Insectorum, fasc. 88, tab. 2, fig. 12.

Erotylus jaspideus minor KUHNT, 1908, Deutsche Ent. Zeitschr., p. 95.

Black, the elytra with reddish to dark reddish round spots that are usually small but very numerous so that they are mostly reddish in color. The punctures are in paired rows, rather large, and there are usually a number of scattered punctures between the rows. The two outer paired rows begin near the humeri; all are obsolete at the posterior fourth. The front tibiae of the male are gently swollen, but this character is not nearly so conspicuous as in *maculatus*. The prosternal lines are obsolete posteriorly.

There are specimens before me from Rio de Janeiro and Santa Catharina in Brazil and several localities in Peru.

E. pustulatus was originally described from Brazil and was misidentified by Lacordaire, who described a quite different species from Surinam under this name. He has been followed by all other students up to the present time, but reference to Duponchel's figure leaves no room for doubt about the species before him. His specimens possibly came from Rio de Janeiro. *E. jaspideus* was described from Peru, and the series before me looks slightly different from the Brazilian specimens, but I can find no way to separate them. The size ranges from 11.5 to 15 mm. The variety *minor* Kuhnt is only a small specimen and does not deserve recognition.

Erotylina brazilianus Kuhnt

Erotylus jaspideus brazilianus KUHNT, 1908, Deutsche Ent. Zeitschr., p. 96.

Entirely like *pustulatus*, but the coxal lines of the prosternum are very strong and extend to the posterior margin. The elytra are said by Kuhnt to be more tapering, which seems to be the case in the three specimens (from Goyas, Brazil) before me. One of the specimens is very dark with the reddish spots obscure dorsally. Three specimens from Villeta, Paraguay, are moderately dark but do not differ from the Brazilian specimens in other respects.

Despite the differences enumerated, I believe that this form should be placed as a synonym of *pustulatus* and am inclined to believe that *intermedia* and *connectens* are in the same category. The difference in shape is not impressive, and the series of *pustulatus* shows some difference in this respect. I do not know how much value can be placed upon the prosternal lines but suspect that they vary considerably. It seems likely that large series will connect these four forms, and possibly *dichromostigma* Guerin.

Erotylina foveatus Kuhnt

Figure 14

Erotylus foveatus KUHNT, 1908, Deutsche Ent. Zeitschr., p. 95.

Erotylus pustulatus LACORDAIRE, 1842, Monogr. Erotylidae, p. 437 (not Duponchel).

Black, the elytra with large roundish or irregular reddish spots arranged more or less in longitudinal rows, the epipleura black and reddish. The black may form oblique bands, but these are somewhat irregular, and a series might show this arrangement to be of no value in distinguishing the species. The front tibiae of the male are less swollen apically and less concave before the apex than in the following species.

Two specimens from Surinam, the type locality.

This species resembles *pustulatus* but has the reddish spots larger and the punctures larger and not in regular paired rows, although they are not very numerous except laterally near the posterior fourth. This is undoubtedly the species identified by Lacordaire as *pustulatus*, but it is probably not the same as that so identified by other authors. I believe it is distinct from any described species, but some specimens may be difficult to separate from the following species.

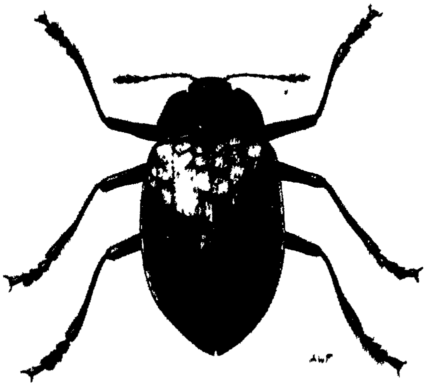

Fig. 14. *Erotylina foveatus.*

Erotylina scutellatus Kuhnt

Figure 15

Erotylus scutellatus KUHNT, 1908, Deutsche Ent. Zeitschr., p. 97.

Black, the elytra with large, roundish, reddish spots and with large punctures, those on the inner half in more or less regular paired lines, the elytra with or without a broad median band devoid of reddish spots; scutellum reddish. The coxal lines on the prosternum extend strongly to the posterior margin.

Kuhnt described the species from Colombia, basing it chiefly on the reddish scutellum. This character seems to be of little importance, and the same is true of the fact that there is a swelling on the scutellum. This latter is present in some specimens of other species. This species, if I have correctly identified it, is very close to that which has generally been identified as *pustulatus*, but it is somewhat less shining and of a brick-red color.

I have two specimens from Colombia, but only one of them fits the above description. The other has the prosternum as in the following species and has the scutellum black, but there is no other difference and I believe that they belong together. However, both are females and it is possible that males might have some structural difference.

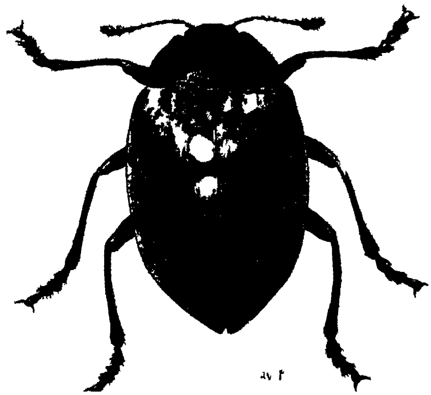

Fig. 15. *Erotylina scutellatus.*

Erotylina vixen, new species

Erotylus pustulatus Auct.

Shining black, the elytra with numerous large, orange red spots that usually leave a broad, median, black fascia, the apex sometimes broadly black, the epipleura black and red. The lines on the prosternum are obsolete posteriorly, and the large punctures are in rows on the inner half, irregularly placed toward the sides. In some specimens there may be six irregular rows of more or less paired lines of punctures, but usually only the inner two or four rows are distinct, and even these are sometimes slightly confused owing to the presence of scattered punctures.

Eleven specimens from Teffe, Brazil (H. Bassler). Holotype, male, October 24, allotype, female, November 24.

Further collecting may show that this is the same as the species described by Kuhnt as *scutellatus*, but since it is not possible to be certain of the identity of his species and since he considered this to be *pustulatus*, it seems advisable to give it a name for the present. However, I suspect that this and the two preceding are forms of one species and that they will be found to intergrade.

Erotylina bassleri, new species

Figure 16

Moderately shining black, the elytra pale orange with base, median fascia, and the apex black. Length, 17 mm.; width, 9 mm.

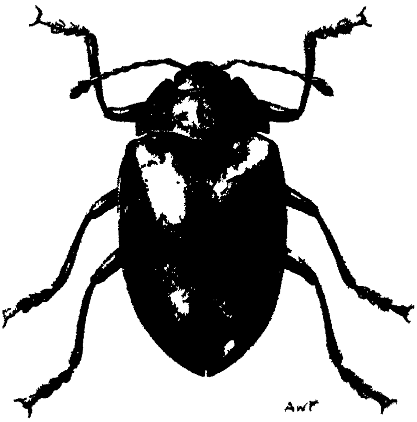

Fig. 16. *Erotylina bassleri.*

MALE: Prothorax almost twice as wide as long, the sides strongly convex, the depressions deep, numerous small punctures and a few large, scattered ones on the disk. Anterior tibiae moderately swollen at apex. Elytra dull orange with a greatly abbreviated basal black band that is very broadly separated from the lateral margins and contains two pale spots on each side of the suture: these pale spots may form the irregular posterior border of the basal band, and there may be one or two black spots on the pale ground; median black band of moderate width, somewhat irregular, with two or three weak anterior projections and a single, narrow posterior one; apical fourth black with a small pale spot. Punctures large and mostly irregularly placed, but the inner paired rows are moderately distinct. Epipleura brown in the middle and apically.

HOLOTYPE: Male, middle Rio Ucayali, Peru, February 12, 1928 (H. Bassler).

The elytral punctures are quite visible to the naked eye. This species seems to be related to *cornaliae* Guerin, but I have not found a specimen that agrees with the description. In my specimen there is a transverse row of faint black spots running across the second pale fascia on one elytron and partly across the other.

Erotylus cornaliae and *E. glaber* Kuhnt, which is probably a synonym, may belong to *Erotylina* but this can only be determined by examination of correctly identified material.

Erotylina scita, new species

Figure 17

Moderately shining black, the elytra each with a broad median fascia, two very large basal spots and very large preapical spot dull orange. Length, about 18 mm.; width, 9 mm.

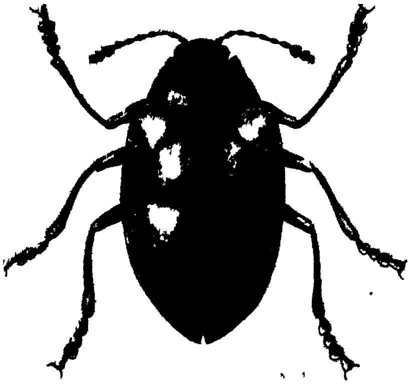

Fig. 17. *Erotylina scita.*

FEMALE: Thorax very much broader than long, the depressions moderately deep, the sides moderately narrowing in front, gently sinuate, but rather straight; numerous small but no large punctures. Front tibiae simple. Each elytron has an extremely large pale spot on the humeral angles and a smaller one obliquely behind it toward the suture; the very broad median pale fascia is very narrowly interrupted at the suture and is shallowly indented toward the side anteriorly and near the middle posteriorly, otherwise rather regular, but gently broadened laterally; the preapical spots form a broad, interrupted fascia. The punctures are large, those on the inner half in paired rows, the outer ones confused but quite sparse toward the lateral margin. The epipleura is black and orange, the pale bands all extending over the lateral margins.

TYPES: Holotype, female, Zamora, Ecuador; paratype, Ecuador, received from Mr. L. Lacey.

The type specimen lacks its head but is otherwise in very good condition. I know of no species that approaches it in color. The punctures are easily visible to the naked eye. In the second specimen, which is undoubtedly conspecific, the color is bright orange, and it is larger; the two anterior elytral spots are partly connected and the median orange band is considerably broader.

Erotylina helopioides Duponchel

Erotylus helopioides DUPONCHEL, 1825, Mem. Mus. Hist. Nat., Paris, vol. 12, p. 40, fig. 11; LACORDAIRE, 1842, Monogr. Erotylidae, p. 447; KUHNT, 1908, Deutsch Ent. Zeitschr., p. 92.

Shining black, the pronotum dull and almost as long as wide, the depressions shallow. Elytra with a rather broad, dentate sub-basal pale fascia containing a number of black spots and united with the median fascia outside the middle of each elytron, the median fascia broad and with black spots laterally; at the apical third with another broad, dentate, pale fascia that has two black projections in front and a long one behind. Length, 15 to 16.5 mm.

Three specimens from Brazil.

Two of the specimens have the pale elytral markings orange, but in the third they are yellow and there is, in this specimen, a reddish spot on the disk of the prothorax. The elytra are without punctures.

Erotylina lacordairei Lacordaire

Figure 18

Erotylus lacordairei LACORDAIRE, 1842, Monogr. Erotylidae, p. 446.

This has been placed as a synonym of *helopioides* by Kuhnt, probably correctly so. It differs in having the second and

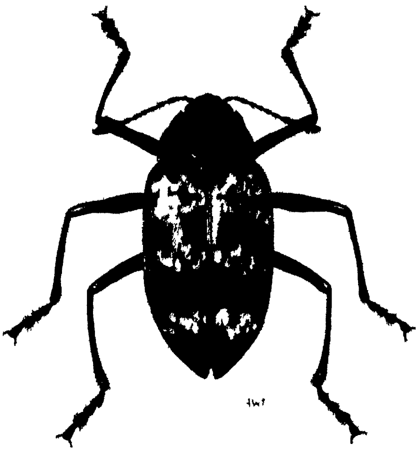

Fig. 18. *Erotylina lacordairei.*

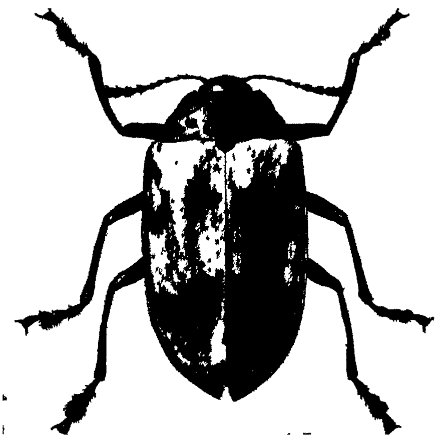

Fig. 19. *Erotylina buquetii.*

third yellow fasciae very narrow and strongly dentate. In the two specimens before me, from southeastern Brazil, the markings are yellow.

Erotylina buquetii Lacordaire

Figure 19

Erotylus buquetii Lacordaire, 1842, Monogr. Erotylidae, p. 445.

Black, the elytra luteous or dull yellowish, each with two brownish or blackish fasciae, one near the basal third, the other near the apical third. The fasciae are irregular and are actually composed of two spots, the outer one situated behind the inner but usually touching it in front; the dark markings are narrowly separated from the suture and the lateral margin.

Two specimens from Santa Catharina, Brazil.

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A REPORT ON MARYLAND SPIDERS

BY MARTIN H. MUMA[1]

The distributional records and the descriptions of new species contained in this paper are extracts from data collected in the course of a systematic study of spiders found in Maryland. Most of the material studied was collected by the author from 1940 through 1942, although a large number of specimens were collected by Dr. Walter F. Jeffers in 1937. Occasional species collected by other workers have been appropriately credited.

A total of 384 species and varieties representing 151 genera and 26 families were identified and recorded during the study. These species were distributed as follows:

Ctenizidae	2	Oxyopidae	3
Atypidae	2	Theridiidae	39
Oecobiidae	2	Linyphiidae	26
Scytodidae	2	Argiopidae	51
Pholcidae	2	Thomisidae	36
Mimetidae	3	Gnaphosidae	15
Uloboridae	2	Clubionidae	21
Dictynidae	8	Salticidae	45
Micryphantidae	39	Segestriidae	1
Amaurobiidae	4	Dysderidae	1
Agelenidae	19	Oonopidae	1
Pisauridae	11	Hahniidae	4
Lycosidae	36	Anyphaenidae	7

Of the 14 new species identified, all but the eight described here have been, or are being, described by other workers. Altogether 74 species are recorded in this paper.

The types of the described species, with representative specimens of the more interesting records, are deposited in the collection of the American Museum of Natural History, while the bulk of the material is in the collection of the University of Maryland.

Acknowledgment is due Dr. Willis J. Gertsch for his assistance and direction without which the study and this paper would not have been possible.

SUBORDER MYGALOMORPHAE

Ctenizidae

Antrodiaetus shoemakeri (Petrunkevitch)

Brachybothrium shoemakeri PETRUNKEVITCH, 1925, Ann. Ent. Soc. Amer., vol. 18, p. 318, pl. 20, figs. 3, 5, 6, 11.

ECOLOGY: One male washed down into sunken porch during rain storm. Other workers record it from river banks.

DISTRIBUTION: Prince Georges County, College Park (M. H. Muma and W. Jeffers), male.

Atypidae

Atypus bicolor Lucas

Atypus bicolor LUCAS, 1836, Ann. Soc. Ent. France, vol. 5, p. 213, pl. 5, fig. 5.

ECOLOGY: The tubular webs of this species are built at the bases of trees, particularly young white oaks. They extend 12 or more inches into the ground and 4 to 8 inches up the trees. Some webs may be built on vertical banks or large stones. All the webs seen by the author have been in low sandy land, but others have been found by other workers on hillsides and crests.

DISTRIBUTION: Prince Georges County, College Park, three females; Prince Georges County, Camp Roosevelt (recorded by H. S. Barber), two males.

SUBORDER DIPNEUMONOMORPHAE

Oecobiidae

Oecobius texanus Bryant

Oecobius texanus BRYANT, 1936, Psyche, vol. 43, p. 87, fig. 8a–8e.

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[1] University of Maryland (extracts from Ph.D. thesis).

Ecology: Warm, dry, dusty buildings are the environs of this species. They are usually found on, under, and around stacked newspapers, magazines, or books.

Distribution: Prince Georges County, College Park (M. H. Muma and K. E. Muma), female and young.

Scytodidae

Loxosceles marylandicus, new species

Figure 1

Male: Total length, 6.75 mm.; carapace length, 3 mm.; carapace width, 2.7 mm.; abdomen length, 3.75 mm.; abdomen width, 2.1 mm. Leg formula, 2143. Carapace, first leg ratio, 1 to 8.5.

Coloration in alcohol typical for genus. Carapace dusky yellow darkening to reddish brown on the cephalic part. Sternum yellow, labium and endites yellow at base and reddish brown at apex. Chelicerae reddish brown. Palpi yellow except for tarsi which are reddish brown. Legs have the femora yellow with all other segments a reddish brown and lighter below than above.

All segments and appendages of the cephalothorax have red margins. Abdomen a yellowish gray somewhat lighter below than above. Spinnerets colored like abdomen.

Structure typical. Cephalothorax more than twice as wide in the thoracic part as in the cephalic part, clypeus more than three times as wide as one anterior eye, slanting, and essentially straight in profile. The three eye groups form a strongly recurved row and are separated by a little less than twice the diameter of one anterior eye. Brown hairs and spines on thoracic part of cephalothorax scattered; on cephalic part spines arranged more or less in rows extending from the anterior margin over the eye region back to the cervical groove; carapace margined with groups of stout curved spines. Fang of chelicerae opposed by a stout spur; chelicerae fused for one-third of their length. Tibia of palpus about twice as long as wide; bulb of palpus as wide as, or wider than, length of alveolus; embolus strongly bent. Legs heavily spined, with anterior faces of first femora most densely clothed

Abdomen heavily clothed with long brown hair. Anterior spinnerets longer than posterior spinnerets and separated by a colulus.

Type Locality: College Park, Maryland; male holotype collected on a log, April 9, 1941.

Dictynidae

Dictyna formidolosa Gertsch and Ivie

Dictyna formidolosa Gertsch and Ivie, 1936, Amer. Mus. Novitates, no. 858, p. 10.

Dictyna armata Banks, 1911, Proc. Acad. Nat. Sci. Philadelphia, p. 444, pl. 34, fig. 9. Not *Dictyna armata* Thorell, 1875.

Ecology: Only one specimen, a female, has been sifted from hardwood leaves in Maryland.

Distribution: Allegany County, Cumberland, female.

Scotolathys pallidus (Marx)

Neophanes pallidus Marx, 1890, Proc. Ent. Soc. Washington, vol. 2, p. 34.

Ecology: This species has been taken by sifting sphagnum moss and moist leaves.

Distribution: Prince Georges County, College Park, male.

Micryphantidae

Aduva flaveola (Banks)

Tmeticus flaveolus Banks, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 39, pl. 4, fig. 15.

Ecology: The one male collected in Maryland was taken by sweeping meadowland.

Distribution: Prince Georges County, Berwyn, male.

Ceratinops carolina (Banks)

Diplocephalus carolinus Banks, 1911, Proc. Acad. Nat. Sci. Philadelphia, p. 447, pl. 34, fig. 2.

Ecology: One pair of spiders belonging to this species was taken by sweeping herbage near a stream bank.

Distribution: Garrett County, Swallow Falls, male and female.

Dicymbium elongatum (Emerton)

Lophomma elongata Emerton, 1882, Trans. Connecticut Acad. Sci., vol. 6, p. 44, pl. 10, fig. 2.

Ecology: Two males of this species were sifted from sphagnum moss.

Distribution: Prince Georges County, Branchville, two males.

Erigone tenuipalpus (Emerton)

Tmeticus tenuipalpus Emerton, 1911, Trans. Connecticut Acad. Sci., vol 16, p. 395, pl. 3, fig 4.

Ecology: Of the two males collected in Maryland, one was taken by sifting sphagnum moss, the other by sweeping grasses.

Distribution: Prince Georges County, College Park (E. Beardsley), male.

Scyletria jona Bishop and Crosby

Scyletria jona Bishop and Crosby, 1938, Jour New York Ent. Soc., vol. 46, p. 90, figs 75–76.

Ecology: A pair of spiders belonging to this species was sifted from moderately dry leaves in Maryland.

Distribution: Prince Georges County, Lanham, male and female.

Souessoula parva (Banks)

Tmeticus parvus Banks, 1899, Proc. Ent. Soc. Washington, vol. 4, p. 192.

Ecology: Several specimens have been sifted from moderately dry leaves in the state.

Distribution: Prince Georges County, College Park, male and female.

Amaurobiidae

Titanoeca brunnea Emerton

Titanoeca brunnea Emerton, 1888, Trans. Connecticut Acad. Sci., vol. 7, p. 452, pl. 10, fig. 5.

Ecology: One male found under a log.

Distribution: Prince Georges County, College Park, male.

Agelenidae

Coras angularis, new species

Figures 2, 3

Male: Total length, 8.55 mm.; carapace length, 4.05 mm.; carapace width, 2.7 mm.; abdomen length, 4.5 mm.; abdomen width, 2.4 mm.

Color of male in alcohol essentially that of genus. Carapace light yellow, darker on cephalic part and over eyes; dark wedge-shaped bands typical of genus present but not extending to margins, forming a broad light marginal band on thoracic part of carapace. Sternum brownish gray with a narrow yellow band running from the anterior margin two-thirds the length of the sternum. Endites light yellow, dusky on the inner margins; labium brownish gray. Chelicerae dusky brown with conspicuous yellow lateral condyles. Palpi light yellow except for a light gray transverse band on the femora. Femora of legs light yellow with three gray transverse bands on the under surface; other segments of legs light yellow with traces and suggestions of transverse bands.

Dorsum of abdomen mottled with dark gray and light yellow, the most uniform marks being a dusky gray basal median lanceolate band extending more than one-half the length of the abdomen and behind which is a series of alternating light yellow and dark gray broken chevrons. Venter mottled gray and yellow with two light parallel lines extending from epigastric furrow to spinnerets; spinnerets dusky gray.

Body robust, legs moderately long, and chelicerae quite robust. Anterior eye row lightly procurved, posterior row moderately so; median ocular quadrangle as wide as long and slightly narrowed behind. All eyes except the anterior medians are subequal in size; anterior medians larger than other eyes by a ratio of 3 to 1.75. Clypeus little wider than the diameter of one anterior median eye. Lower margin of furrow of chelicerae with three teeth, upper margin with three. Patella of palpus furnished with two lateral processes at the apical end; they are short and well separated, the anterior one acute at the tip, the posterior rounded. Legs furnished with typical long stout spines; coxae with longitudinal ridge on anterior face. Spinnerets typical of group, posterior spinnerets twice the length of the anteriors and widely separated.

Type Locality: Swallow Falls State Park, Maryland; male holotype collected under bark, August 24, 1942.

This species is closely related to *C. medicinalis* Hentz from which it may be distinguished by details of the palpus.

Coras crescentis, new species

Figure 5

FEMALE: Total length, 9.75 mm.; carapace length, 4.35 mm.; carapace width, 3 mm.; abdomen length, 5.4 mm.; abdomen width, 3.6 mm.

In alcohol, carapace dusky yellow darkening to light brown on cephalic part; radiating bands on thoracic part dusky brown and not extending to lateral and posterior margins, forming a wide lateral band of yellow on thoracic part. Sternum light brown with a narrow yellow median band running its entire length. Labium and endites light brown, dusky at the margins. Chelicerae dark reddish brown with distinct light brown lateral condyle. Palpi yellowish brown with tarsi somewhat darker than other segments. Legs yellowish brown above and below with the tarsi and metatarsi darker than other segments; femora with three dusky transverse bands below.

Abdomen mottled grayish brown and yellow with a dark median longitudinal herringbone stripe. Venter marked longitudinally with two wide dusky brown stripes extending from epigastric furrow to spinnerets. Spinnerets light brown.

Structure typical; body and chelicerae robust; legs moderately long and stout. Anterior eye row lightly procurved, posterior row moderately so; median ocular quadrangle as long as wide and slightly narrowed in front. All eyes subequal except anterior medians which are larger by the ratio of 2.5 to 2. Clypeus slightly wider than the diameter of an anterior median eye. Upper and lower margins of the furrow of the chelicerae with three teeth. Legs spined with typical long stout spines; coxae with longitudinal ridge on anterior face. Spinnerets typical. Epigynum with opening near anterior margin, usual median longitudinal groove absent.

TYPE LOCALITY: Dans Rock near Vale Summit, Maryland; female holotype collected under a board, November 23, 1941.

This species is similar to *C. lamellosus* (Keyserling), from which it may be distinguished by the smaller size, more distinct abdominal pattern, and details of the epigynum.

Coras lamellosus (Keyserling)

Figure 4

Coelotes lamellosus KEYSERLING, 1887, Verhandl. Zool.-Bot. Gesellsch. Wien, p. 469.

ECOLOGY: This species has been found under bark in one locality in Maryland.

DISTRIBUTION: Garrett County, Deep Creek Lake, male and female.

Coras parallelis, new species

Figure 6

FEMALE: Total length, 10.2 mm.; carapace length, 4.8 mm.; carapace width, 3.45 mm.; abdomen length, 5.4 mm.; abdomen width, 3.9 mm.

Carapace in alcohol yellow darkening to reddish brown on cephalic part; typical brownish gray wedge-shaped radiating bands on thoracic part not extending to margins, leaving wide marginal band. Sternum brown with indistinct light median longitudinal stripe. Labium and endites brown, darker at margins. Chelicerae dark reddish brown. Palpi yellowish brown darkening on terminal segments. Legs yellowish brown above and below darkening on metatarsi and tarsi. Femora with three grayish brown transverse bands below.

Abdomen mottled with gray and light yellow; there is a suggestion of the usual basal lanceolate mark and broken chevrons. Venter light with several irregular dark spots forming two indistinct longitudinal bands extending from the epigastric furrow to the light brown spinnerets.

Structure typical, body robust, chelicerae robust and legs moderately long and stout with typical long stout spines. Coxae of legs with longitudinal ridge on anterior face. Anterior eye row lightly procurved, posterior row moderately so. Median ocular quadrangle as long as wide and slightly narrowed in front. All eyes subequal except anterior medians which are larger by a ratio of 2.75 to 2. Clypeus 1.8 times the diameter of one anterior median eye. Spinnerets typical of group with posterior pair more than twice as long as anterior pair. Median groove of the epigynum long with parallel sides.

TYPE LOCALITY: Princess Anne, Maryland; female holotype collected on ground, October 29, 1941, by W. Barb.

This species is close to *C. medicinalis* Hentz from which it may be separated by details of the epigynum.

Pisauridae

Thanatidius dubius (Hentz)

Thomisus dubius HENTZ, 1847, Jour. Boston Soc. Nat. Hist., vol. 5, p. 448, pl. 23, fig. 11.

ECOLOGY: The only specimens taken in Maryland were collected beside water.

DISTRIBUTION: Calvert County, Solomon's Island (R. A. Littleford), male; Prince Georges County, College Park, female.

Lycosidae

Lycosa sepulchralis Montgomery

Lycosa sepulchralis MONTGOMERY, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 543.

ECOLOGY: This species is found under boards, stones, and logs, on dry hillsides and occasionally in houses.

DISTRIBUTION: Anne Arundel County, Bay Ridge, female; Cecil County, North East, female; Howard County, Ellicott City (G. Vogt), female; Kent County, Pleasant Hill, male; Prince Georges County, Berwyn (E. Beardsley), female.

Lycosa shenandoa (Chamberlin and Ivie)

Trochosa shenandoa CHAMBERLIN AND IVIE, 1942, Bull. Univ. Utah, vol. 32, p. 37, fig. 78.

ECOLOGY: Two females of this species have been found under boards near water in Maryland.

DISTRIBUTION: Calvert County, Scientist's Cliffs, female; Prince Georges County, Laurel (L. P. Ditman), female.

Pardosa xerampelina (Keyserling)

Lycosa xerampelina KEYSERLING, 1876, Verhandl. Zool.-Bot. Gesellsch. Wien, p. 662.

ECOLOGY: One female of this species was found under a stone on a rocky beach.

DISTRIBUTION: Garrett County, Deep Creek Lake, female.

Schizocosa duplex Chamberlin

Schizocosa duplex CHAMBERLIN, 1924, Bull. Mus. Comp. Zool., vol. 67, p. 231.

ECOLOGY: Only one male found under a board in open woodland has been identified from Maryland by the author.

DISTRIBUTION: Montgomery County, Forestville (recorded by I. Fox), male; Prince Georges County, Berwyn (E. Beardsley), male.

Oxyopidae

Oxyopes aglossus Chamberlin

Oxyopes aglossus CHAMBERLIN, 1929, Ent. News, vol. 40, p. 17, figs. 1–2.

ECOLOGY: Two females have been collected in Maryland by beating brush.

DISTRIBUTION: Calvert County, Solomon's Island (R. A. Littleford), female; Prince Georges County, College Park, female.

Theridiidae

Conopistha ocula, new species

Figure 7

FEMALE: Total length, 4.35 mm.; carapace length, 1.65 mm.; carapace width, 1.2 mm.; abdomen length, 2.7 mm.; abdomen width, 2.55 mm.; abdomen height, 3.3 mm. Leg formula, 1243.

In alcohol, carapace a reticulate reddish brown, darker at margins and over eye region; conspicuous markings consist of three short, wide, dark bands in the middle near the posterior margin, a pair of dark, wide, S-shaped bands on either side of the median furrow, a pair of thin, parallel, dark bands extending posteriorly from the posterior median eyes to the posterior edge of the cephalic part, a pair of inwardly curving thin dark bands extending from posterior lateral eyes to the posterior edge of the cephalic part, and two light S-shaped marks on the clypeus. Legs dark brown, marked with lighter elongate reticulate areas. Sternum, labium, and endites dark brown with labium and endites lighter at apical ends. Palpi dark brown and marked like legs. Chelicerae dark reticulate brown, lighter at base.

Abdomen a reticulate brown, somewhat lighter than carapace, with short dark striae. Conspicuous markings consist of two light indistinct longitudinal bands extending from the pedicel up toward the apex and ending in two light eye-shaped areas complete with dark eyelashes and light eyebrows, an indistinct light crescent at the apex of the abdomen whose backward curving tips partly enclose a pair of light irregular spots, and three light indistinct inverted U-shaped marks over the spinnerets. Spinnerets dark brown. Venter brown with two irregular light areas just in front of spinnerets.

Structure of carapace typical of genus; anterior median eyes situated on broad tubercle which projects somewhat over strongly convex clypeus. Both eye rows lightly procurved in face view. Median ocular quadrangle slightly wider than long and narrowed slightly in front. Eyes of posterior row subequal; anterior median eyes about 1.5 the size of the anterior laterals. Sternum truncate with undulate lateral margins; labium wider than long and fused to sternum, endites wider at apex than at base. Cephalothorax naked except for a few curved spines on the cephalic region and on the margins. Legs moderately long and weakly spined; serrate comb on fourth tarsi distinct but consisting of only four or five bristles.

Abdomen bluntly triangular in outline having greater height than length or width and possessing two flattened irregular humps at the apex. Spinnerets very short and contiguous. Abdomen clothed with pale erect bristles. Openings of epigynum roughly triangular in outline and separated by less than the width of one opening.

TYPE LOCALITY: Salisbury, Maryland; female holotype collected on web of *Metepeira labyrinthea* Hentz, June 26, 1942, by W. Jeffers.

Dipoena dorsata, new species

Figure 8

FEMALE: Total length, 1.8 mm.; carapace length, 0.7 mm.; carapace width, 0.6 mm.; abdomen length, 1.1 mm.; abdomen width, 0.7 mm. Leg formula, 1423.

In alcohol, carapace dusky yellow with a darker reticulum radiating in all directions from a dark central shield-shaped area; eye area dark. Sternum, labium, and endites dusky yellow with the latter somewhat lighter. Legs and palpi dark yellow with the proximal ends of the tibiae, metatarsi, and tarsi furnished with wide dark rings.

Abdomen brownish gray, finely spotted and streaked with gray; venter somewhat lighter than dorsum with two narrow gray stripes extending from the epigastric furrow to the spinnerets. Spinnerets yellow.

Structure typical of genus. Carapace broadly oval in outline, somewhat narrower in the cephalic region and arched high in the eye region. Anterior eye row moderately procurved, posterior row strongly so; eyes of posterior row with lateral eyes slightly smaller than medians; anterior median eyes about twice the size of the anterior laterals; lateral eyes sub-contiguous; anterior median eyes separated by the diameter of one; median ocular quadrangle five times as wide as long and narrowed behind. Anterior median eyes situated on a broad tubercle projecting over clypeus; clypeus slightly convex and three times the diameter of an anterior median eye in width. Sternum truncate with lateral margins undulate and projecting between posterior coxae, separating them widely; labium wider than long, fused to the sternum and enclosed by strongly convergent endites. Legs moderately long and weakly spined. Carapace naked except for several spines on clypeus.

Abdomen oval in outline and gently flattened dorsally; abdomen clothed with many short dark spines above and below. Anterior spinnerets longer than posterior pair. Epigynum as figured.

TYPE LOCALITY: Churchville, Maryland; female holotype collected under board, June 28, 1941. College Park, Maryland; immature female paratype collected by sifting leaves, October 19, 1941. College Park, Maryland; immature female paratype collected by sifting leaves, April 19, 1941.

Episinus amoenus Banks

Episinus amoenus Banks, 1911, Proc. Acad. Nat. Sci. Philadelphia, p. 445, pl. 35, figs. 13, 15.

Ecology: This spider runs about on the foliage of low bushes and trees, from which it may be collected by sweeping.

Distribution: Dorchester County, Sharptown, male; Prince Georges County, College Park (E. Beardsley), female.

Euryopis argentea Emerton

Euryopis argentea Emerton, 1882, Trans. Connecticut Acad. Sci., vol. 6, p. 27, pl. 5, fig. 5.

Ecology: This species has been taken by sifting leaves and beating brush in Maryland.

Distribution: Allegany County, Cumberland, young male; Somerset County, Princess Anne, male.

Theridion australe (Banks)

Theridium australe Banks, 1899, Proc. Ent. Soc. Washington, vol. 4, p. 191.

Ecology: Most of the specimens of this species have been taken from the nest of the steel blue mud dauber. One female was collected under a board.

Distribution: Queen Annes County, Matapeake, female; Wicomico County, Salisbury (W. Jeffers), 25 females and male.

Theridion pennsylvanicum (Emerton)

Theridium pennsylvanicum Emerton, 1913, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 255, fig. 1, pl. 48.

Ecology: One male collected in the state was taken by sweeping low herbs and brush.

Distribution: Montgomery County, Silver Spring, male.

Theridion punctosparsum (Emerton)

Theridium punctosparsum Emerton, 1882, Trans. Connecticut Acad. Sci., vol. 6, p. 12, pl. 1, fig. 6.

Ecology: This species is found under stones and boards, and in cool buildings such as milk sheds and spring houses.

Distribution: Allegany County, Rocky Gap (H. E. Muma), female; Harford County, Churchville, male and female; Prince Georges County, College Park (E. Enzor), female.

Theridion redemptum Gertsch and Mulaik

Theridion redemptum Gertsch and Mulaik, 1936, Amer. Mus. Novitates, no. 863, p. 13, figs. 14–15.

Ecology: The webs of this species are found on or near the ground, usually under boards and other litter.

Distribution: Frederick County, Lewistown, male; Prince Georges County, College Park (E. Enzor), female.

Theridion reticulateum, new species

Figures 9, 10

Male: Total length, 1.8 mm.; carapace length, 0.7 mm.; carapace width, 0.6 mm.; abdomen length, 1.1 mm.; abdomen width, 1 mm. Leg formula, 1423.

In alcohol, carapace pale yellow with a narrow black median band extending backward from the posterior eye row to the median furrow, margins seamed with black. Eyes narrowly ringed with reddish brown except for anterior medians which are ringed with black. Sternum pale yellow, seamed with black. Labium, endites, and chelicerae slightly darker than sternum. Legs pale yellow, slightly darker at distal ends of segments; femora, patellae, tibiae, and metatarsi with incomplete dark rings below or on anterior face near distal end.

Abdomen a reticulated chalky white marked dorsally with a longitudinal undulating folium having indistinct dusky margins. Venter marked transversely just behind epigastric furrow with a broad chalky white reticulate band. Spinnerets pale yellow.

Clypeus convex and divided longitudinally into two flattened lobes; width of clypeus three times the diameter of one anterior median eye. Eyes situated on a low broad tubercle; anterior row lightly procurved, posterior row moderately so; all eyes are subequal except for anterior medians which are slightly smaller. Median ocular quadrangle slightly wider than long and narrowed behind; lateral eyes contiguous; anterior medians separated by the diameter of one. Carapace roughly oval in outline, tapering to the front, and provided with several curved spines on the cephalic part. Legs moderately long and weakly spined. Embolus as figured.

Abdomen subglobose and clothed with pale erect hairs. Spinnerets contiguous.

TYPE LOCALITY: College Park, Maryland; male holotype collected by sweeping, November 6, 1941, by E. Beardsley; male paratype collected in garden, August, 1942, in Baltimore, Maryland, by I. P. Schloss.

This species is closely related to *T. dulcineum* Gertsch and Archer. It may be distinguished from that species by the dorsal abdominal pattern and by details of the palpus.

Linyphiidae

Microneta olivacea Emerton

Microneta olivacea EMERTON, 1882, Trans. Connecticut Acad. Sci., vol. 6, p. 75, pl. 24, fig. 7.

ECOLOGY: Several specimens of this species were sifted from leaves in moist woodland.

DISTRIBUTION: Prince Georges County, College Park, three females and male.

Nesticus pallidus Emerton

Nesticus pallidus EMERTON, 1875, Amer. Nat., vol. 9, p. 279.

ECOLOGY: This species has been found in caves in complete darkness, but it also occurs out of doors under stones and boards.

DISTRIBUTION: Prince Georges County, Berwyn (W. Jeffers), female; Washington County, Crystal Grottoes (K. E. Muma), three females.

Argiopidae

Aranea miniata (Walckenaer)

Epeira miniata WALCKENAER, 1837, Hist. Nat. Insectes Aptères, vol. 2, p. 39.

ECOLOGY: This species has been collected in Maryland by beating and sweeping low bushes and herbs. The author has not seen the web.

DISTRIBUTION: Caroline County, Ridgely (L. P. Ditman and G. Vogt), female; Prince Georges County, Berwyn (E. Beardsley), female; Somerset County, Dividing Creek Swamp, young female; Wicomico County, Salisbury (W. Jeffers), two females.

Aranea nivea (Hentz)

Epeira nivea HENTZ, 1847, Jour. Boston Soc. Nat. Hist., vol. 5, p. 474, pl. 31, fig. 9.

ECOLOGY: All but one specimen of this species have been taken from mud daubers' nests. One male was found on the top of an automobile where it had apparently fallen from a tree. This species apparently has two forms or varieties. One variety has unmarked legs and cephalothorax, while the other has the yellow of these parts heavily spotted with red.

DISTRIBUTION: Prince Georges County, Berwyn (W. Jeffers), 11 males and nine females; Wicomico County, Salisbury (W. Jeffers), three young males and five females.

Aranea nordmanni (Thorell)

Epeira nordmanni THORELL, 1870, Remarks on Synonyms of European Spiders, p. 4.

ECOLOGY: This species has been taken in dense woodland near water. The webs are vertical and are on small trees or tall bushes between 3 and 6 feet off the ground. The spiders rest in silken nests built in curled leaves at upper angles of the webs.

DISTRIBUTION: Garrett County, Boiling Springs, two females; Wicomico County, Salisbury (W. Jeffers), female.

Mastophora bisaccata (Emerton)

Cyrtarachne bisaccata EMERTON, 1885, Trans. Connecticut Acad. Sci., vol. 6, p. 325, pl. 34, fig. 11.

ECOLOGY: One female of this species was found clinging to a shattered web in dense woodland. An egg case believed to be that of this species was jug-shaped and fastened securely to a small twig.

DISTRIBUTION: Anne Arundel County, Annapolis, female.

Mimognatha foxi (McCook)

Theridium foxi McCOOK, 1893, Amer. Spiders, vol. 3, pl. 29, fig. 1.

ECOLOGY: One male of this species was collected in Maryland by sweeping grasses.

DISTRIBUTION: Prince Georges County, Berwyn, male.

Neoscona domicilorum (Hentz)

Epeira domicilorum HENTZ, 1847, Jour. Boston Soc. Nat. Hist., vol. 5, p. 469, pl. 3, fig. 7.

Ecology: Three females of this well-marked species were taken from webs similar to those of *N. benjamina* Walckenaer in open woodland.

Distribution: Somerset County, Dividing Creek Swamp, three females.

Pachygnatha furcillata Keyserling

Pachygnatha furcillata Keyserling, 1883, Verhandl. Zool.-Bot. Gesellsch. Wien, p. 661.

Ecology: All specimens of this species collected in the state have been taken by sweeping over swamps or by sifting leaves over swampy land.

Distribution: Garrett County, Deep Creek Lake, male; Prince Georges County, College Park, two females and male; Somerset County, Dividing Creek Swamp, male.

Thomisidae

Philodromus inaequipes Banks

Philodromus inaequipes Banks, 1900, Canadian Ent., p. 99.

Ecology: Two specimens of this species were taken in Maryland by sweeping bushes.

Distribution: Cecil County, North East, female; Prince Georges County, Riverdale, female.

Philodromus laticeps Keyserling

Philodromus laticeps Keyserling, 1880, Die Spinnen Amerikas, vol. 1, p. 215.

Ecology: All specimens of the species were collected from wasps' nests.

Distribution: Prince Georges County, Berwyn (W. Jeffers), eight females; Wicomico County, Salisbury (W. Jeffers), two females.

Tmarus rubromaculatus Keyserling

Tmarus rubromaculatus Keyserling, 1880, Die Spinnen Amerikas, vol. 1, p. 158, pl. 3, fig. 86.

Ecology: One male of this species was collected by sweeping low bushes.

Distribution: Wicomico County, Salisbury, male.

Xysticus banksi Bryant

Xysticus banksi Bryant, 1930, Psyche, vol. 37, p. 138, figs. 11, 12, 14.

Ecology: One female of this species was taken by sweeping in an orchard.

Distribution: Harford County, Churchville, female.

Xysticus discursans Keyserling

Xysticus discursans Keyserling, 1880, Die Spinnen Amerikas, vol. 1, p. 20, pl. 1, fig. 7.

Ecology: One male was found on the ground in the state.

Distribution: Prince Georges County, Lanham (E. Enzor and R. Rhine), male.

Gnaphosidae

Drassodes robinsoni Chamberlin

Drassodes robinsoni Chamberlin, 1919, Ann. Ent. Soc. Amer., vol. 12, p. 245, pl. 16, fig. 2.

Ecology: One female of this species was found under a log.

Distribution: Prince Georges County, Berwyn, female.

Drassyllus depressus (Emerton)

Prosthesima depressa Emerton, 1909, Trans. Connecticut Acad. Sci., vol. 8, p. 173, pl. 3, fig. 8.

Ecology: This species may be found under boards and stones on the ground and occasionally in houses.

Distribution: Garrett County, Deep Creek Lake, female; Montgomery County, Woodside (J. H. Fales), male; Prince Georges County, College Park, male.

Drassyllus femoralis (Banks)

Zelotes femoralis Banks, 1904, Proc. California Acad. Sci., ser. 3, vol. 3, p. 336, pl. 38, fig. 1.

Ecology: Only two specimens were taken and put in the author's collection, one from Maryland and one from Washington, D. C. Both were taken in buildings.

Distribution: Prince Georges County, College Park (R. Ballinger), female; Washington, D. C. (K. A. Dorsey), female.

Drassyllus frigidus (Banks)

Prosthesima frigida Banks, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 17, pl. 1, fig. 56.

Ecology: This species is found under boards and stones on the ground.

Distribution: Allegany County, Dans

Rock (H. E. Muma), male; Cecil County, Pleasant Hill, male; Prince Georges County, College Park (J. Oltman), male; Worcester County, Pocomoke City, male.

Drassyllus rufulus (Banks)

Prosthesima rufula BANKS, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 17, pl. 1, fig. 55.

ECOLOGY: One female of this species was found under a board in the state.

DISTRIBUTION: Prince Georges County, College Park (E. Enzor), female.

Drassyllus sporadicus, new species

Figures 11, 12

MALE: Total length, 2.8 mm.; carapace length, 1.2 mm.; carapace width, 1 mm.; abdomen length, 1.6 mm.; abdomen width, 0.9 mm.

Carapace in alcohol yellow narrowly seamed with black. Eyes finely bordered reddish brown; anterior medians set on a black spot. Sternum and mouth parts yellow; sternum seamed with brown. Legs dusky yellow with apical segments darker.

Abdomen gray with metallic reflections and unmarked except for dusky yellow shield on the anterior third. Venter gray and marked with two fine parallel longitudinal lines. Spinnerets light yellow.

Structure typical; carapace flat and oval in outline. Both eye rows gently procurved and nearly equal in length with the anterior row being slightly smaller. Anterior median eyes about one-third the size of the anterior laterals, separated from each other by slightly less than the diameter of one, but subcontiguous with the laterals. Eyes of posterior rows subcontiguous, with the oblique median eyes being contiguous; median eyes larger than lateral eyes by the ratio of about 8 to 7. Median ocular area longer than wide by the ratio of 2 to 2.5 and narrowed in front by about that ratio. Clypeus narrow; less than the diameter of the anterior lateral eyes. Upper margin of the furrow of the chelicerae with four teeth, lower margin with three, the most proximal being largest. Anterior tibiae with no spines above or below. Anterior metatarsi with a pair of spines near the base below but no spine above. Second tibia with a single median spine below, but no spine above. Second metatarsi with a pair of spines near the base below but no spine above.

Abdomen generally tubular in form. Spinnerets proportionately long, the anterior pair measuring 0.4 mm., and the posterior pair 0.31 mm.

TYPE LOCALITY: Parole, Maryland; male holotype collected under a board, June 9, 1942.

Litopyllus rupicolens Chamberlin

Litopyllus rupicolens CHAMBERLIN, 1922, Proc. Biol. Soc. Washington, vol. 35, p. 155.

ECOLOGY: One female of this species was collected by sifting moist leaves.

DISTRIBUTION: Prince Georges County, College Park, female.

Clubionidae

Castianeira lineata Emerton

Castianeira lineata EMERTON, 1909, Trans. Connecticut Acad. Sci., vol. 14, p. 216, pl. 10, fig. 5.

ECOLOGY: One female of this species was found on the ground by Walter F. Jeffers.

DISTRIBUTION: Wicomico County, Salisbury (W. Jeffers), female.

Castianeira variata Gertsch

Castianeira variata GERTSCH, 1942, Amer. Mus. Novitates, no. 1195, pp. 6–7, fig. 21.

ECOLOGY: One male found under board on ground.

DISTRIBUTION: Harford County, Churchville, male.

Marcellina piscatoria (Hentz)

Clubiona piscatoria HENTZ, 1847, Jour. Boston Soc. Nat. Hist., vol. 5, p. 450, pl. 23, fig. 15.

ECOLOGY: All specimens of this species were collected from trees at night with the use of spotlight.

DISTRIBUTION: Prince Georges County, College Park, male.

Meriola decepta Banks

Meriola decepta BANKS, 1895, Jour. New York Ent. Soc., p. 81.

ECOLOGY: All specimens of this species

collected in the state were taken over newly plowed ground or on leaves of corn stalks standing in the field.

DISTRIBUTION: Cecil County, Elkton, female; Kent County, Fairlee, female; Prince Georges County, Lanham, three males; Washington County, Delamere (R. W. Muma), female.

Phrurolithus brittoni Gertsch

Phrurolithus brittoni GERTSCH, 1941, Amer. Mus. Novitates, no. 1147, p 14, figs. 34–36.

ECOLOGY: One male of this species was collected under a log in the state.

DISTRIBUTION: Garrett County, Deep Creek Lake, male.

Phrurotimpus kentuckyense (Chamberlin and Gertsch)

Phrurolithus kentuckyense CHAMBERLIN AND GERTSCH, 1940, Amer. Mus. Novitates, no. 1123, p. 9, figs. 31, 32.

ECOLOGY: Specimens of this species have been taken under logs and stones and by sifting leaves.

DISTRIBUTION: Baltimore County, Loch Raven, female; Cecil County, Pleasant Hill, female; Garrett County, Deep Creek Lake, female; Prince Georges County, College Park (I. Schloss), male.

Phrurotimpus umbratilis (Bishop and Crosby)

Phrurolithus umbratilis BISHOP AND CROSBY, 1933, Ann. Ent. Soc. Amer., vol. 26, p. 152.

ECOLOGY: This species has been taken once in Maryland by sweeping.

DISTRIBUTION: Dorchester County, Sharptown, female.

Salticidae

Metaphidippus castaneus (Hentz)

Attus castaneus HENTZ, 1846, Jour. Boston Soc. Nat. Hist., vol. 5, p. 353.

ECOLOGY: One female of this species was found on the ground.

DISTRIBUTION: Prince Georges County, Lanham (J. Oltman), female.

Metaphidippus virginis (Chamberlin)

Dendryphantes virginis CHAMBERLIN, 1925, Bull. Mus. Comp. Zool., vol. 62, p. 233.

ECOLOGY: Same as that of *M. capitatus* Peckham. It is found on weeds, scrub pines, and other plants in dry open fields. It may be collected by sweeping these plants.

DISTRIBUTION: Allegany County, Cumberland, male; Prince Georges County, College Park, male.

Parnaenus chrysis (Walckenaer)

Attus chrysis WALCKENAER, 1837, Hist. Nat. Insectes Aptères, vol. 1, p. 454.

ECOLOGY: These large spiders are found on bushes and trees. They may occasionally be taken by sweeping, but never in numbers.

DISTRIBUTION: Cecil County, Colora, male; Harford County, Churchville, male; Montgomery County, Pennyfield, female; Prince Georges County, Berwyn (W. Jeffers), three females and two males.

Phidippus McCookii (Peckham)

Attus McCookii PECKHAM, 1883, Descr. Attidae U. S., p. 16

ECOLOGY: This species is found on bushes and trees in open woodland and shaded fields.

DISTRIBUTION: Baltimore County, Catonsville (G. Vogt), female; Montgomery County (R. W. Muma), female; Prince Georges County, College Park (G. Vogt), male.

Phidippus mystaceus (Hentz)

Attus mystaceus HENTZ, 1846, Jour. Boston, Soc. Nat. Hist., vol. 5, p. 355.

ECOLOGY: The ecology of this species is not known to the author as all specimens were collected from wasps' nests, except one male taken in an automobile.

DISTRIBUTION: Prince Georges County, College Park (E. G. Meyer), male; Wicomico County, Salisbury (W. Jeffers), male and two females.

Phidippus putnami (Peckham)

Attus putnami PECKHAM, 1883, Descr. Attidae U. S., p. 1.

ECOLOGY: This spider is found on trees, bushes, and weeds in fields and orchards. It may be taken in numbers by sweeping.

DISTRIBUTION: Cecil County, Colora, female and three males; Harford County, Churchville, male and female; Prince Georges County, Berwyn (W. Jeffers), six females.

Sassacus papenhoei Peckham

Sassacus papenhoei Peckham, 1895, Occas. Papers Nat. Hist. Soc. Wisconsin, vol. 2, no. 3, p. 177.

Ecology: Only males of this interesting species have been taken in Maryland. They were collected by sweeping hot, dry, open fields.

Distribution: Calvert County, Bertha, male; Montgomery County, Silver Spring, male; Prince Georges County, Riverdale, male.

Sidusa borealis Banks

Sidusa borealis Banks, 1904, Jour. New York Ent. Soc., vol. 12, p. 116.

Ecology: This species has been found in one locality in Maryland, in, on, and around greenhouses.

Distribution: Prince Georges County, College Park, two males and two females.

Oonopidae

Orchestina saltitans Banks

Orchestina saltitans Banks, 1894, Ent. News, p. 300.

Ecology: This small species is found in warm, dry buildings.

Distribution: Prince Georges County, College Park, female.

Hahniidae

Hahnia flaviceps Emerton

Hahnia flaviceps Emerton, 1913, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 257, pl. 58, fig. 6–6d.

Ecology: Three females of this species were sifted from sphagnum moss.

Distribution: Prince Georges County, Branchville (K. E. Muma), three females.

Neoantistea barrowsi Gertsch

Neoantistea barrowsi Gertsch, 1934, Amer. Mus. Novitates, no. 712, p. 29, figs. 36–37.

Ecology: This species has been found on the ground and under boards on the ground.

Distribution: Anne Arundel County, Gibson Island, female; Prince Georges County, Beaver Dam Country Club, Landover, male.

Anyphaenidae

Anyphaena fragilis Banks

Anyphaena fragilis Banks, 1897, Canadian Ent., p. 194.

Ecology: Two females of this species have been taken from wasps' nests by Walter F. Jeffers.

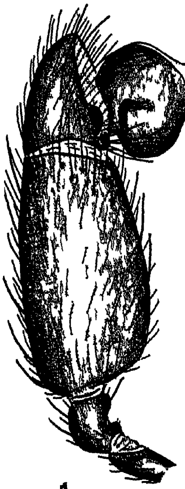
Distribution: Prince Georges County, Berwyn (W. Jeffers), female; Wicomico County, Salisbury (W. Jeffers), female.

Anyphaenella albens (Hentz)

Clubiona albens Hentz, 1847, Jour. Boston Soc. Nat. Hist., vol. 5, p. 454.

Ecology: One male of this species was taken by beating brush.

Distribution: Prince Georges County, College Park, male.



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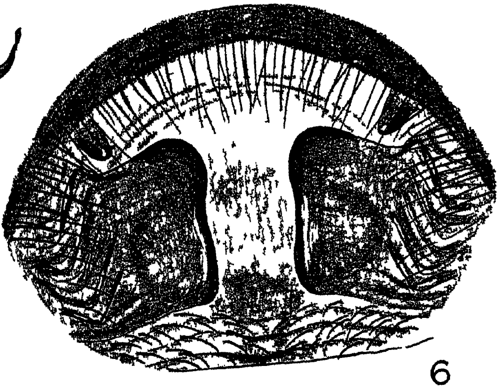

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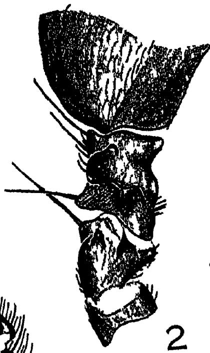

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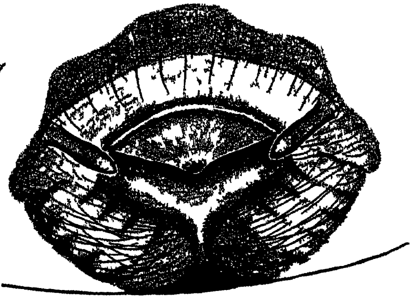

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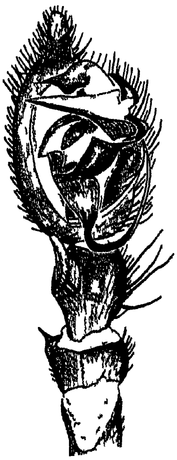

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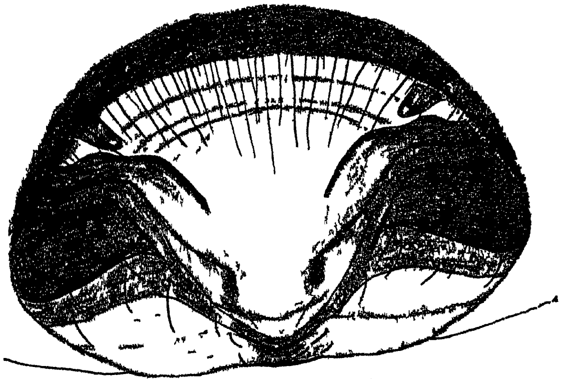

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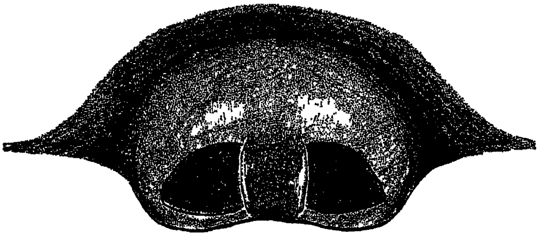
Fig 1 *Loxosceles marylandicus*, new species, palpus, lateral view
Fig 2 *Coras angularis* new species, lateral view of palpal patella and tibia
Fig 3 Idem, palpus, subventral view
Fig 4 *Coras lamellosus* (Keyserling), epigynum, ventral view.
Fig 5 *Coras crescentis*, new species, epigynum, ventral view
Fig 6 *Coras parallelis*, new species, epigynum, ventral view



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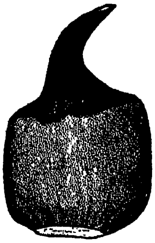

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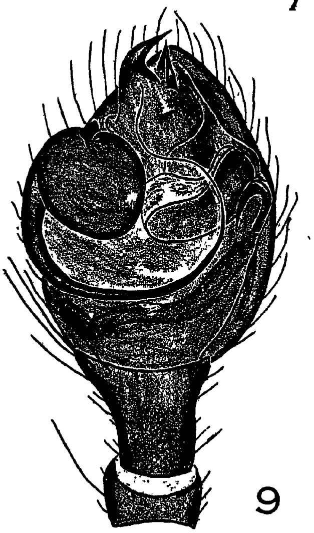

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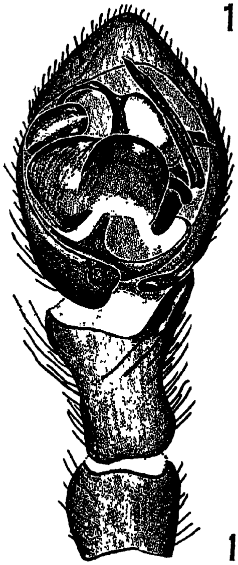

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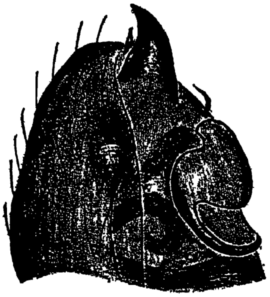

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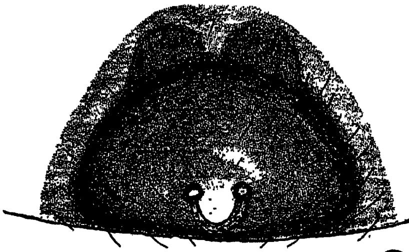

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Fig. 7. *Conopistha ocula*, new species, epigynum, ventral view.
Fig. 8. *Dipoena dorsata*, new species, epigynum, ventral view.
Fig. 9. *Theridion reticulateum*, new species, palpus, subventral view.
Fig. 10. Idem, tip of palpus, lateral view.
Fig. 11. *Drassyllus sporadicus*, new species, palpus, subventral view.
Fig. 12. Idem, tibia of palpus, lateral view.

AMERICAN MUSEUM NOVITATES

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GOMPHUS CONSANGUIS SELYS (ODONATA)

By Elsie Broughton Klots[1]

Gomphus consanguis was described in 1879 by the Baron Edmond de Selys-Longchamps from a single male specimen collected in North Carolina. No subsequent records are to be found.[2] In the American Museum of Natural History there is a specimen which I have attributed to this species, although it has not been compared with the type and differs from the description of it in several minor respects.

Male: Length: abdomen, including appendages, 36 mm.; hind wing, 32 mm.; stigma, 3.3 mm.

Face and head of dried specimen yellowish white, marked with black. Labium with median lobe black. Labrum with a wide anterior border and a narrow posterior border and a median spot black; posterolateral corners pale. The median spot tends to become diffuse crosswise and might sometimes appear as a cross band. Anteclypeus infuscated across its width, paler in the center and darker at the sides and near the clypeal suture. Frontoclypeal suture with a black band, narrower on the median line and then abruptly widened to conjoin the impressed black point on either side and then narrowed again laterally. A small pale spot is left in the center of each of the expansions. Rear border of top of frons black, merging at right angles into the black of the vertex. Ocelli and basal segment of the antennae narrowly ringed with yellow. Occiput black with a large median yellow spot astride the elevated rear border, continuing down farther on the rear surface. Postocellary swellings connected by a low concave ridge.

Prothorax black with a broad yellow band on the anterior border of the front lobe, a large yellowish spot and two small lateral spots on the median lobe. Synthorax pale greenish yellow, marked with black as follows: a pair of dorsal stripes, fused and widened anteriorly to form a triangle which is narrowly interrupted by the yellow of the crest, widely separated by a yellow collar from the black below, and faintly and narrowly joined on one side of the thorax with the antehumeral stripe above the collar; antehumeral and humeral stripes confluent, separated from each other by a round superior spot and a narrow line, the spot and the line separated from each other by a distance equal to one-half the length of the line; a narrow stripe on the first lateral suture joined above and below with the humeral stripe and interrupted above the spiracle for one-fourth its length; a stripe on the second lateral suture which is joined above with that of the first lateral suture and with the black of the anterior half of the alar carinae of the metepimeron, and bent rearward below to join the black on the ventral angle of the metepimeron. Spiracle black rimmed. Anterior two-thirds of the mesinfraepisternum and the anterior half of the metinfraepisternum black. There is also a black spot on the axillary beneath the costal margin of each wing. Notum bright yellow with anterior and lateral margins of each segment black.

Coxae pale, each with a black basal spot. Legs black except for a pale line on the outer surface of the femora, this pale line punctuated with black spines. Venation, including costa, black; stigma brown, covering four and one-half cells

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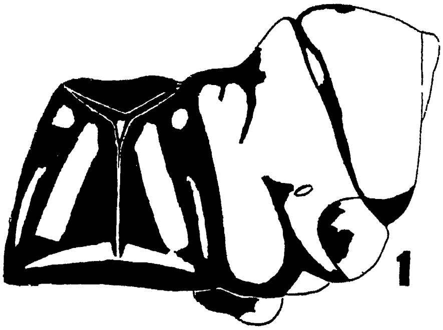
[1] Finch Junior College, New York City.

[2] Since the preparation of this manuscript, a nymph collected in Cataloochie Creek, near Morgantown, North Carolina, by J. G. Needham, has been described as *G. consanguis* on supposition. (James G. Needham, 1943, Bull. Brooklyn Ent. Soc., vol. 35, pp. 149–150.)



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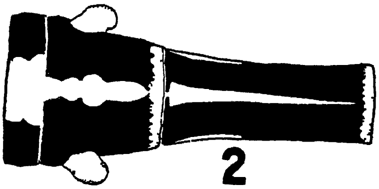

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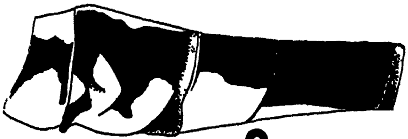

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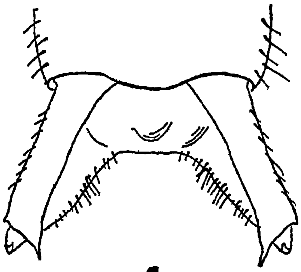

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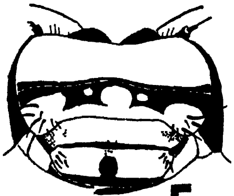

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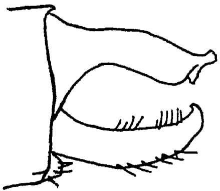

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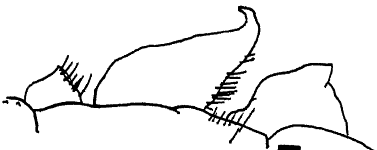

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Fig 1 Diagram of thoracic color pattern
Fig 2 Diagram of abdominal color pattern, dorsal view, segments 1–3
Fig 3 Diagram of abdominal color pattern, lateral view, segments 1–3
Fig 4. Abdominal appendages, dorsal aspect
Fig 5 Diagram of facial color pattern
Fig 6 Abdominal appendages, lateral aspect
Fig 7 Genitalia of second abdominal segment, lateral aspect

in the fore wing, five and one-half in the hind wing. Antenodals of the fore wing 13–14, postnodals 12; antenodals of the hind wing 10, postnodals 12.

Abdomen mainly black. Segment 1 with a median dorsal yellow band and with broad yellow lateroventral margins; segment 2 with a stalked, trilobed middorsal spot, a small lateral basal spot and a large elongate spot on the lateral margin extending upward to include the auricle and again in a rounded lobe near the posterior margin; outermost tip of the auricle black; segments 3 to 7 with an attenuated triangle on the middorsal line, extending four-fifths of the segment length on segment 3, one-fourth the segment length on 4, successively smaller on 5 and 6, and narrowly to about two-thirds the segment length on 7. On each of these segments the triangle is continued as a faint hair line for the entire segment length. Segments 2 to 6 are ringed with brown beyond the apical carinae, the brown on 2 and 3 narrowly margined with yellow; segments 7 to 9 yellow beyond the apical carinae. Lateral margins of segment 3 with a broad yellow border, narrower beyond the median carina; margins of segments 4 to 9 with narrow yellow borders, slightly wider on the posterior half of 7 and covering the expanded portions of segments 8 and 9, extending diffusely up onto the sides of segment 8. Segment 10 and appendages black. Segment 9 one-third shorter than 8 and nearly as long as 10 plus the appendages. Appendages widely and equally divaricate; superiors, from above, slender, cylindrical, and truncate, prolonged within to a sharp point and from the side showing a ventral tooth; inferiors with upturned tips.

One male in the American Museum of Natural History, collected by W. Beutenmueller in "Valley of Black Mountains," North Carolina, June 25, 1906.

This specimen differs from the original description in the absence of the small yellow spot behind the median ocellus, in the black instead of the yellow occiput, in the confluence of the humeral and antehumeral stripes and in the interruption of the first lateral stripe. There are no round yellow spots on the sides of segments 4 to 7 of this specimen, although there are narrow yellow lateral margins.

It differs from *Gomphus parvidens* Currie in the confluence of the humeral and antehumeral stripes, in its larger size (type of *parvidens:* length of abdomen including appendages, 28.5 mm.; hind wing, 24 mm.), and in the equal divarication of the superior and inferior appendages. It differs from *brevis* Hagen most conspicuously in its appendages. It differs from *adelphus* Selys in its smaller size, shorter stigma, and the strong point on each side of the superior appendage.

It so strongly resembles *Gomphus rogersi*, as described by Gloyd (three paratypes of which are from near Black Mountain, Buncomb County, North Carolina), that I was convinced at once that they were the same. I am informed by Mrs. Gloyd that when she described *G. rogersi* she considered the possibility of its being *consanguis* Selys, but after comparing it carefully with the Selys' description she concluded that the differences were specific. Upon reëxamining her detailed and careful description of *rogersi* and comparing it with the original description of *consanguis*, I fully appreciate her conclusions, but I believe the specimen described here shows relationship with Selys' *consanguis* that was not evident in her material.

The labrum of the specimen in the American Museum has the median spot of *consanguis* but a transverse diffusion that hints at the cross band of *rogersi*. The occiput resembles *rogersi* in being black with a yellow spot on its rear surface but approaches the pale occiput of *consanguis* in having this spot overspreading the border and showing from the anterior surface. The color of the occiput is not a variable character, and it is hardly likely that in one species the color would range from the black of Gloyd's specimens to the yellow occiput of Selys' specimen, but I think it is quite possible that Selys, in seeing the yellow median spot, might have thought the entire occiput yellow with the lateral corners obscured.

The complete black band on the second lateral suture of the thorax of this specimen resembles *consanguis* and not *rogersi* which has this stripe reduced to a wedge-shaped spot above, obscurely connected with a line below. But this difference is no greater than the difference shown by some of the paratypes of *rogersi* which have the humeral and antehumeral stripes separate instead of partially confluent as in the type.

The basal dorsal spots on abdominal segments 3 to 7 are continued in a hair line the full length of the segments in this specimen as in *consanguis*, but the absence of the hair line continuation in *rogersi* is scarcely significant. The lateral spots on abdominal segments 3 to 7 are not present in this specimen or in *rogersi* as they are in the description of *consanguis*, but the yellow lateral margins are.

Mrs. Gloyd sent me recently some sketches which Dr. Eric Schmidt made for her in 1937. Schmidt could find no specimen in the Selys collection labeled "*consanguis*," but he did find a male from North Carolina, collected by Morrison, with the label *Gomphus melanogaster*."[1] The sketches which he sent show that it resembles the American Museum specimen in the transverse elongation of the spot on the labrum, the infuscation on the outer corners of the anteclypeus, and the shape of the frontoclypeal band. It agrees with our specimen and *rogersi* but differs from the original description of *consanguis* as follows: the occiput is black with a small yellow spot on the midline of the elevated border; the lateral stripe on the first lateral suture is interrupted above the spiracle; and the humeral and antehumeral stripes are partially confluent, leaving between them a superior spot and an inferior line.[2] It differs from ours and from *rogersi* but resembles the description of *consanguis* in showing a large yellow spot at the rear of the median ocellus.

The genitalia and the terminal appendages of the three appear to be the same except that the inner tip of the superior appendages of the specimen studied by Schmidt is less prolonged.

A brief summary of the main comparative differences of the specimens discussed in this paper may be expressed in tabular form:

	A.M.N.H. SPECIMEN	DESCRIPTION OF *consanguis*	SCHMIDT'S SKETCHES	*rogersi*
Occiput	Black with median spot	Yellow	Black with median spot	Black with median spot on rear
Labrum	Median spot diffuse transversely	Median spot	Median spot elongated transversely	Median cross band
Yellow spot at median ocellus	Absent	Present	Present	Absent
Humeral and antehumeral stripes	Confluent	Separate	Confluent	Confluent (and separate)
1st lateral stripe	Interrupted	Complete	Interrupted	Interrupted
2d lateral stripe	Complete	Complete	Diffusely interrupted	Diffusely interrupted

I believe that the American Museum specimen, the one studied by Schmidt, and *rogersi* are the same species. I believe they are all *consanguis*. It is yet to be established with certainty that the one studied by Schmidt is the actual type of the species. If it is, Selys' description is faulty; if it is not, I think that the type, when located, will show no greater differences from the others of this complex than do many of the other species of *Gomphus* within themselves.

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[1] This specimen, according to Schmidt, also bears a label "No. 47." In Selys' "Monographie des Gomphines" (1858, Mem. Soc. Roy. Liége, vol. 11, pp. 257–715), No. 47 is *G. pallidus* which is the same size but which is otherwise quite different.

[2] Some of the paratypes of *rogersi* do not have them confluent. This would indicate that a variation within the species is possible but does not explain the difference between Selys' description of *consanguis* and the specimen studied by Schmidt.

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NOTES ON THE GOMPHINAE (ODONATA) WITH DESCRIPTIONS OF NEW SPECIES

BY ELSIE BROUGHTON KLOTS[1]

A study of gomphine wing venation extending over a period of 15 years or more has brought to my attention many specimens of unusual interest. It seems advisable at this time to publish notes on some of these under one title, though they bear no relationship other than that the specimens are to be found in the American Museum of Natural History. They are as follows:

1. A possible new species of *Diaphlebia* from Venezuela, with notes on the venation of *Diaphlebia* and *Desmogomphus*.
2. A new genus and species from Peru.
3. A new species of *Phyllogomphus* from the Congo, with notes on *Phyllogomphus coloratus* Kimmins.
4. A species of *Notogomphus* from Ethiopia which differs venationally from the genotype.
5. A new species of *Oxygomphus* from the Congo.

Diaphlebia species

Figures 5, 6, 18

LENGTH: Abdomen, including appendages, 36.8 mm.; appendages, 2 mm.; hind wing, 32 mm.; stigma, 5.5 mm.

FEMALE: Lips and head pale brownish; labrum with lateral margins and a minute median spot black; postclypeus with a narrow black mark on the anterolateral corners; ocelli ringed with yellow; vertex dark brown, prominent, coming to a point behind each rear ocellus, these two peaks connected by a concave ridge; border of occiput concave.

Prothorax obscured. Synthorax pale brown with a pair of green dorsal stripes divergent forward and separated from the narrow green collar; a narrow antehumeral stripe bent forward at its upper end and slightly widened at its lower end. Mesepimeron obscured but apparently with two irregular longitudinal pale stripes. Metepimeron with a broad pale band covering most of its area.

Legs pale with black spines; tibiae and tarsi darker. Wings hyaline with black veins and tawny stigma; widest at the proximal end of the stigma. Antenodal cross veins of the fore wing 16–17, the first and the seventh thickened; of the hind wing 12–13, the first and the sixth thickened. Postnodal cross veins of the fore wing 15, of the hind wing 14. Cross veins under the stigma, in addition to the brace vein, six to seven in the fore wing, eight in the hind. Fore and hind wing discoidal triangle crossed; subtriangle and supratriangle free. Costal side of the fore wing triangle slightly longer than the proximal side; costal side of the hind wing triangle more than twice as long as the proximal side. Distal side of both triangles broken. Discoidal field of both wings of two rows of cells, in the fore wing increasing to three cells at the level of the nodus, and in the hind wing increasing halfway between the median fork and the nodus. Cross veins before the median fork seven in the fore wing, four in the hind; median fork slightly asymmetrical. Sectors of the arculus rising just below its middle and separated from each other by a distance greater than the width of either.

Abdomen brown, marked with yellow as follows: segment 2 with a narrow trilobed spot on the middorsal line and a ventral lateral band extending the length of the segment; segment 3 with the ventral lateral band its full length but reduced

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[1] Finch Junior College, New York City.

on the apical fourth; segments 4 to 7 with basal twin spots fused with the pale ventral margins, on 4 to 6 the spots are small, but on 7 they extend one-third the segment length and almost meet on the middorsal line. Segments 8 to 10 all brown. Apical carinae of 3 to 10 narrowly black and on each of these segments a minute, black lateroventral spot on the intersegmental membrane. Appendages pale brown, black tipped, longer than segment 10 and about as long as segment 9. Vulvar scale elongate, tapering, slightly protuberant, and bifid to two-thirds its length; the two lobes approximated, reaching almost to the end of segment 9.

MATERIAL: Female, Mt. Duida, Venezuela, March 3, 1929 (G. H. H. Tate), in the American Museum of Natural History.

Investigation has shown that there are very few specimens of *Diaphlebia* known. Since Selys' descriptions, only *D. nexans* Calvert has been described, and no other references have been made to the two Selysian species. In fact, when Selys described *semilibera* (1869) he suggested it might prove to be another *angustipennis*, its chief apparent difference being the absence of cross veins in all triangles except the discoidal triangles of the hind wing. In this respect the American Museum specimen is more like *semilibera*, but it is smaller, has a richer wing venation, and differs in the coloration of the abdomen.

It differs from *angustipennis* Selys in its richer wing venation, the presence of black marks on the labrum and postclypeus, and the distinct trilobed spot on abdominal segment 2. It differs from the description of the male of *nexans* Calvert in its larger size, the richer wing venation, the slightly longer triangles, and the coloration of the abdomen.

Although this specimen in the American Museum does show these differences from the other known species, there is too little comparative material available to warrant its description as new. It does add, however, to our knowledge of the venational range of the genus. It agrees with Calvert's characterization of the genus (1903) differing only in minor respects: the first and seventh antenodals of the fore wing are the thickened ones instead of the first and fifth; the fore wing triangles are not so far removed from the arculus as the length of the proximal side of the triangle; the venation is richer throughout. It agrees with only three of the characters in Needham's verification table (1940, p. 389): the absence of the basal subcostal cross veins (and even this character may not hold, for there is a basal subcostal in one of the hind wings of this specimen), the possession of two cell rows in the discoidal field of the triangle of the fore wing, and the asymmetry of the median fork. It thus invalidates the presence or absence of cross veins in the fore wing triangle and the number of postanal cells as generic characters for distinguishing *Diaphlebia* from *Desmogomphus*, and raises the question as to whether these two genera can be distinguished on venational characters. The triangles of *D. angustipennis* in the Cornell collection are longer than those of the type of *Desmogomphus*, but an analysis of the five specimens of *Desmogomphus* which I have been able to study shows some variation in the character. If a value of 10 be ascribed to the length of the proximal side of the triangle, the ratios of the proximal, the costal, and the distal sides are as follows: *Desmogomphus*, fore wing 10:10–12:11–12, hind wing 10:16–21:16–24; *Diaphlebia* sp., fore wing 10:13:15, hind wing 10:23:26; *Diaphlebia angustipennis*, fore wing 10:14:15, hind wing 10:20:23. Any estimate of the proportions of the triangles of *nexans* taken from the figure would necessarily be very inexact, but the triangles do not seem to be so long as these other representatives of the genus.

The relation of the anal crossing and the origin of A_3 is also variable. In *Diaphlebia*, sp. it rises virtually under *ac*, in *angustipennis* it rises a little beyond *ac*, and in *Desmogomphus* A_3 rises before *ac* in eight of the hind wings and almost underneath in two.

Antenodals of the fore wing in the type of *Desmogomphus* number 12–13, but of the 10 wings which I have studied only one has 12 and three have 13, while four have 14 and two have 15. In *Diaphlebia* they range from the 13–14 of described species to the 16–17 in this specimen.

The size of the stigma seems to remain a good distinguishing character. It is one-eighth the wing length in *Desmogomphus* and one-sixth in *Diaphlebia*.

The hooking of the vein tips in *Diaphlebia* also seems to be a good character. This can best be described, though inadequately, as a downward curve of the sectors M_2, R_s, and R_{sa}, beginning at the level of the proximal end of the stigma and continuing evenly to the wing margin. This curve accompanies a blunt-tipped wing which is usually widest just before the stigma. In the specimens that I have seen of these two genera this serves as a distinguishing character.

PERUVIOGOMPHUS, NEW GENUS

Basal subcostal cross vein present; arculus at, or slightly beyond, the second antenodal cross vein; median fork asymmetrical; nine median cross veins in the fore wing, six in the hind wing; fore wing triangle directed outward, its costal side the shortest and its proximal and distal sides about equal to each other; one row of cells beyond the fore wing triangle as far out as the median fork; one paranal row in the fore wing widening to two rows behind Cu_2. Hind wing triangle slightly broken on its distal side and with one cross vein; A_3 rising before the anal crossing; A_2 rising from under the subtriangle. Stigma braced and surmounting four additional cross veins.

GENOTYPE: *Peruviogomphus moyobambus*, new species.

This genus resembles *Archaegomphus* and *Agriogomphus* in having a single row of cells beyond the triangle of the fore wing but otherwise seems to have no affinities with them. It resembles the Progomphini in having crossed triangles (in this specimen only the supratriangles and the triangle of the hind wing are crossed), a basal subcostal cross vein, a large number of median cross veins, no extra cubito-anal cross veins, nodus beyond the middle of the wing, the stigma with a brace vein, and a tendency for vein A_2 to converge with A_3 distally. It approaches the Epigomphini in the distal position of the arculus, the narrow anal area of the fore wing, the slight hooking of the vein tips, the asymmetry of the median fork, and the large thick stigma. The unusual character of the genitalia of the second abdominal segment, as described for the species, is probably not generic: it has been observed in the genus *Progomphus*.

Peruviogomphus moyobambus, new species

Figures 11–16

In the dried type specimen, the colors are obscured and badly faded. The eyes show distinct traces of iridescent emerald green, and there is some indication that these colors may also have been characteristic of the thorax.

LENGTH: Abdomen, including appendages, 33 mm.; hind wing, 24.5 mm.; stigma, 2.3 mm.

Face, frons, vertex, and occiput pale green, the labrum bordered and possibly crossed with yellow; the postclypeus with anterior margin narrowly bordered with yellow and the outer corners broadly yellow. Frons low, its upper border deeply concave on the median line. Vertex green, the ocelli and base of antennae ringed with yellow; the prominent ridges around the rear ocelli and across the rear border of the vertex yellow. Occiput green, its elevated border nearly straight and narrowly yellow.

Thorax pale, the middorsal black stripe but slightly wider than the pale green stripe on either side and connected above with the wide, black antehumeral; humeral suture with a narrow black stripe which is connected above and below with the antehumeral. Sides all pale green, yellow in the sutures and on the carinae and yellowish ventrally and posteriorly.

Legs yellow, femora streaked with brown on the outside and with two double rows of small irregular black spines; tibiae and tarsi darker. Wings hyaline; antenodal cross veins in the fore wing 17, postnodals 12; antenodals in the hind wing 13; postnodals 12; cells under the stigma four.

Abdomen with colors obscured. Segments 1 and 2 brown with pale markings on the sides, including the auricles which are prominent and black bristled on their posterior surface. Segments 2 to 6 with a wide dorsal brown band forming a complete ring at the apex and partially invaded at the median carina with the yellow of the venter. This brown is finely but distinctly divided by a yellow line on the middorsal carina. Dorsum of 2 with a broad bilobed yellow spot. Segments 3 to 7 have minute blunt black spines scattered along on either side of the middorsal line. Segment 7 with the basal half diffusely yellow; 8 to 10 brown with diffuse dorsal and lateral pale spots. Segments 7 to 9 with a distinct black spot on the apical carina near the ventral margin; segment 10 with apical carina all black. Appendages brown, black-tipped; longer than segment 10. Penis with a pair of long, downward-curved bristles extending well beyond the end of the second segment.

TYPE MATERIAL: Holotype, male, Moyobamba region, Peru, March, 1936 (G. Klug), in the American Museum of Natural History.

Phyllogomphus annulus, new species

Figures 8, 10

LENGTH: Abdomen, including appendages, 61 mm.; hind wing, 48 mm.; stigma, 5.5 mm. Width of hind wing at level of nodus, 12.8 mm.

Face and head mainly brown marked with green. Labium brown, its anterior half paler; mandibles pale green with brown tips; labrum with a pair of pale green spots and with the lateral margins bordered with darker brown; anteclypeus with its lower third horizontal, except on the median line, and with its upper two-thirds vertical and green; postclypeus brown with a large green spot on each side and with nasal punctures yellowish, the pale yellowish continuing laterally along the anterior border; frons brown with a pale green band across the top covering about one-third of the anterior surface and one-half of the upper surface. Vertex brown, black along the eyes; the transverse ocellary ridge with ends bent backward to run along the rear border of the ocelli; antennae brown, second segment black with an apical ring of yellow. Occiput brown, its elevated rear border sinuous.

Prothorax brownish. Synthorax brown, marked with green as follows: the inverted "7," which is broadly interrupted at the corners and the cross piece of which is barely more than a hair line in width; a small spot on the basal half of the middorsal carina; two broad oblique bands on the sides, one under each wing, the first narrowly bordered with black and the second with a broad black band along its anterior margin. This black band is continuous across the dorsal end of the pale band and fades to yellow in the suture preceding it. There is a notal green spot between each pair of wings.

Femora brown, black at the apices; tibiae and tarsi black, tibiae paler basally. Trochanters and femora with many small, blunt, scattered spines.

Wings uniformly enfumed with yellowish, deeper at the wing bases, with black veins and stigma. Antenodals of the fore wing 17, the first and fifth thickened; postnodals 15. Antenodals of the hind wing 14, postnodals 15. No basal subcostal cross veins; arculus arising between the first and second antenodal cross veins; stigma covering five cells. Hind wing with anal loop of four cells; six postanal cells; A_3 rising under the anal crossing.

Abdominal segment 1 brown; segment 2 brown with a pair of green, lateral, basal spots, diffuse and tapering beyond the median carina, and with ventral margins pale as far as the carina; segment 3 brownish with a complete basal yellow ring extending to the median carina, or one-third the segment length, and continuous with the broad yellow ventral margins; segments 4, 5, and 6 all dark, brownish black except for the pale ventral margins; segment 7 brown with a yellow basal half ring extending halfway down the sides and to one-fourth the segment length, and with a small rectangular projection on the middorsal line, ventral margins pale; segments 8 and 9 light yellowish brown on the sides, darker on the dorsum; leaves of segment 8 pleated, black, extending the length of segment 9 and 4 mm. wide at their widest point; segment 10 light reddish brown. Segment 9 is one-half as long as segment 8 and two-thirds as long as segment 10. Segment 10, which bends downward, has a conspicuous dorsal carina with a slight arch in its basal fourth, striking lateral carinae, and many minute transverse encircling ridges.

Vulvar scale extraordinarily long, broad, scoop shaped to the end of segment 9 and then narrowed to a slender projection which ends in a broader, black-tipped fork which reaches to about one-third the length of segment 10. The scoop stands out from the abdomen, but the slender projection bends back and almost touches segment 10.

TYPE MATERIAL: Holotype, female, Medji, Congo, June 26, 1910 (Lang and Chapin), in the American Museum of Natural History.

This beautifully preserved specimen is clearly distinguishable from all described females. It differs from *aethiops* Selys in having but three pale stripes on each side of the middorsal carina of the thorax. It differs from the description of *coloratus* (Kimmins, 1931, did not describe the female because of its poor preservation) as follows: the frons is brown with a green band across the top instead of green margined with brown; the legs have considerable brown on the femora and tibiae; abdominal segment 3 has a distinct and complete basal yellow ring instead of lateral spots; segments 4, 5, and 6 are all brownish black with no lateral basal pale spots; and the lamellae do not seem to be "larger than in *aethiops*." It differs from the description of *selysi* Schouteden (1933) by the greater extent of brown on the face and head, by the yellow ring on segment 3, and by the absence of orange yellow spots on segments 4, 5, and 6. It differs from the MacLachlan female, described as *aethiops* by Selys (1878) and shown by Longfield (1936) not to be *aethiops*, in the greater extent of color on the wings (a character which is, of course, variable), the greater extent of brown on the face, the basal ring on segment 3, and the absence of basal spots on segments 4, 5, and 6.

The vulvar scale should be a good criterion for identification, but unfortunately the vulvar scale of the MacLachlan female is the only one described. It has the forked tip reaching nearly to the end of segment 10, whereas this specimen has it reaching only one-third the length of segment 10.

In the American Museum there are three males of *P. coloratus* Kimmins, collected in the Cameroons, which agree with the original description except in the color pattern of abdominal segment 2. This segment has a middorsal lanceolate pale spot extending to the carina, instead of a thin pale dorsal streak. A female collected at the same time is larger and heavier but differs in color only inasmuch as the poor preservation of color conceals the original pattern of the face and the dorsum of the thorax. It has the vulvar scale very long, reaching nearly to the end of segment 10 (figs. 7, 9), thus resembling the scale of the MacLachlan female.

Notogomphus dorsalis Selys

Figure 19

A female collected in Addis Ababa, Ethiopia, July 5, 1920, altitude 5000 feet, is so different venationally from my conception of this genus that I at first thought to describe it as a new genus. It answers the description of this species so closely, however, that I shall not add further to the complexities of the *Noto-Podogomphus* group by describing it as new. But I do wish to note here the peculiarities of the venation in the hope that some one with more material will make a detailed study of the venational characters and define the limits of variation within this and closely related genera.

The basal subcostal cross vein is present; brace vein present and strongly aslant; stigma surmounting only two and one-half cells; median fork symmetrical with two median cross veins between it and the arculus; triangle large, slightly broken on the outer side, that of the fore wing but little larger than the subtriangle and with its proximal side but very slightly longer than its costal; sectors of the arculus widely separated; two paranal rows and three rows behind Cu_2 of the fore wing. Hind wing with one cubito-anal cross vein; five double postanal rows between A_1 and A_2; A_3 well before the anal crossing; anal crossing distant from the subtriangle by its own length; Cu_1 and Cu_2 separated by four cells at the margin; anal loop of two or three cells.

I very much doubt if this and *Notogomphus ruppelyi* Selys (as figured by Ris, 1909, fig. 5) are congeneric. However, wings figured by Sjostedt (1909, pl. 2, figs. 3–5), Schouteden (1934, fig. 69), and Campion (1923, figs. 1, 3) show intermediate variations. It does seem to differ from them all in the short bridge (a character which I have not studied enough as yet to be able to define), the short stigma, and the double row of cells between A_2 and A_3. The wide area indicated by this character is due, partially of course, to the sex of the specimen.

I add a brief description of the specimen for the benefit of those who may be able to compare it with type material; there is always the possibility that I have incorrectly determined it.

LENGTH: Abdomen, including appendages, 29 mm.; hind wing, 26 mm.; stigma, 2.6 mm. Width of hind wing at the level of the nodus, 9 mm.

Labium brown, median lobe paler basally; labrum yellow, entirely bordered with brown and crossed with a brown band which is marked in the center by a yellow depression; base of mandibles pale yellow; genae dark brown; anteclypeus brown with a pair of round yellow spots in the middle, almost touching; postclypeus and frons yellow with fine brown reticulations, the brown more dense towards the clypeal suture and in the depressions of the nasal punctures; frons high and swollen across the crest, which is slightly notched in the middle and punctuated with six or seven sharp black elevated points on either side; vertex dark brown, slightly lighter behind the postocellary ridge, which is curved to rearward on the midline; occiput convex, very low, light brown, fringed with long black hair. Rear of eyes yellowish brown with a wide black border along the eye margin on either side of the occiput.

Prothorax black with a wide middorsal yellow band. Thorax yellow, marked with brown as follows: the V of the crest, a broad band on each side of the dorsum extending from above the arms of the crest down across the prothorax, gradually widening to reach its greatest width before the collar, each of these bands wider than the middorsal yellow; a narrow band behind the humeral suture; faint narrow brown lines along the alar carinae and in the sutures.

Coxae yellow; femora yellow, lined with black; tibiae and tarsi black. (Hind femora missing.)

Abdomen with a middorsal yellow band extending from segment 1 to segment 8, narrowly interrupted at the apices of all segments and at the median carina of segment 7; separated from the yellow of the sides and venter by a black band which runs full length of the abdomen on each side, the two approximating on the apical fourth of segment 8 and fusing to cover the dorsum of segment 9. Segment 10 brownish with a pair of black spots on the base of the segment. Appendages brown. Vulvar scale broad, the width of the segment notched at the tip and extending not more than one-fifth the length of segment 9.

OXYGOMPHUS LACROIX[1]

Fraser, the first to describe this genus, says that it is distinguished from all other genera by segment 10 which is longer than segment 9 and abruptly constricted, cylindrical in the second half and telescoped into 9; by the occiput which is elevated, recurved forward and surmounted by two or more spines; and by the posterior hamules which project far out and forward toward the base of the abdomen.

A specimen in the American Museum collection has genitalia so like those of *Oxygomphus agilis* (as figured by Fraser) that I place it in that genus without question in my own mind. Its unique tenth segment may well be that described by Fraser, but its simple occiput indicates either that his description of the genus will have to be made more elastic or that a new genus should be described for this species and possibly *martininus* Lacroix.

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[1] Martin (1908) described *Notogomphus agilis* as having a recurved occiput and the last three segments of the abdomen fused. Ris (1909) expressed the opinion that *Notogomphus agilis* Martin was not a true *Notogomphus*. Fraser (1936) ascertained that Martin's *Notogomphus agilis* and the specimen in Martin's collection labeled *Oxygomphus agilis* were the same. When Lacroix described *Oxygomphus martininus* (1921) the genus had not been described, but since he compared his specimen with the type of *O. agilis* this genus is attributed to him by Fraser (1936).

Oxygomphus chapini, new species

Figures 1–4, 17

LENGTH: Abdomen, including appendages, 38 mm.; hind wing, 29 mm.; stigma, 2.8 mm.

Face and frons pale greenish, faintly margined with yellow; labrum with a median, transversely oval depression. Frons low and rounded over the region of the crest, slightly bulbous below the antennae. Vertex brown, the area around the median ocellus and across the front yellow. Antennae brown except for the pale green basal segment. Ocellary ridges completely surrounding the rear ocelli, most conspicuous on the outer side along the margin of the compound eyes. Rear of vertex sloping to the low ridge before the occiput. Occiput brown, almost straight, with only a slight depression on the median line. Rear of eyes brownish with a conspicuous yellow spot on the lateral margins.

Prothorax reddish brown, the vertical sides of the median lobe and a median dorsal twin spot yellow. Synthorax yellow on the dorsum, pale brown on the sides marked with brownish black as follows: a pair of dorsal stripes, widened below and confluent on the midline, forming a narrow triangle which becomes restricted below to form a small inverted cone interrupting the yellow collar and joining the black below; on each side a black antehumeral, connected above and below with the middorsal triangle, leaving an oblique elongate yellow spot on the black of the dorsum each side; a wide black humeral separated from the antehumeral by a yellow stripe one-third again as wide as the antehumeral but not quite so wide as the humeral. First lateral suture with a reddish spot at the top connected with the humeral stripe and a light brownish triangular spot above the spiracle; second lateral suture with a narrow tapering stripe interrupted on the lower third; metepimeron with a triangular dark spot on the posterior margin.

Femora pale; tibiae and tarsi darker. Wings hyaline, veins, including the costa dark brown; stigma light brown, paler in the apical third, surrounded by dark veins. Antenodals 13–14 in the fore wing, 11 in the hind; postnodals 10.

Abdomen brownish with color pattern obscured. Segment 1 yellowish; segment 2 with prominent auricles and with a narrow, irregular, middorsal, pale, lanceolate band four-fifths the segment length; segment 3 with an attenuated middorsal triangle three-fourths the segment length, very obscure, in some lights scarcely visible, with median and apical carinae darker; segments 4, 5, and 6 reddish brown; segments 7, 8, and 9 black on the dorsum, 7 with a brown basal ring one-fourth the segment length; segments 8 and 9 with expanded lateral margins bright yellow and with a middorsal yellow spot on the apical intersegmental membrane; segment 10 brownish with the basal half black and an irregular apical black margin; segment 10 a little longer than 9, abruptly constricted, slender and cylindrical at base as though it might be telescoped into 9, encircled basally with minute ridges.

HOLOTYPE MALE: Lukeolela, left bank of the Congo River, 01° 05′ S., October 13, 1930 (J. P. Chapin), in the American Museum of Natural History.

This species is named for Dr. James P. Chapin of the American Museum.

Oxygomphus chapini is slightly smaller than *agilis* (*agilis* abdomen, 43 mm., hind wing, 31 mm. long) and resembles it strongly as to color pattern and type of appendages, though the superior appendages are more widely divaricate than those of *agilis*, as figured by Fraser (1936). It differs from *agilis* most strikingly in its simple occiput. It differs from the description of *martininus* Lacroix in size (*martininus* abdomen, 51 mm., hind wing, 43.3 mm. long) and in color pattern.

Oxygomphus martininus is known only from a single female, the description of which makes no mention of the occiput or the shape of the tenth segment. In the absence of any description we can only conclude that there is nothing unusual or striking about them. Granting that the peculiarities of the occiput of *agilis* and of the tenth segment of both *agilis* and the male here described as *chapini* may be sexual characters, I still decline to accept *martininus* as the female of either of these males. Martin agreed with Lacroix in thinking *martininus* different from *agilis* (Lacroix, 1921, p. 49). If it was too large for *agilis* (*agilis* abdomen, 43 mm., hind wing, 31 mm. long) it is certainly too large for *chapini*.

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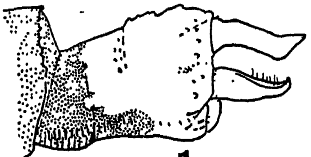
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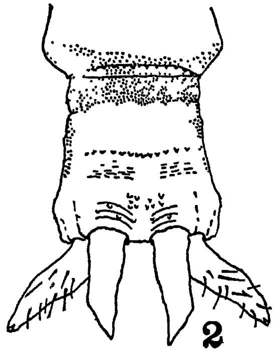
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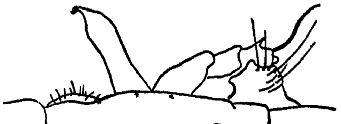
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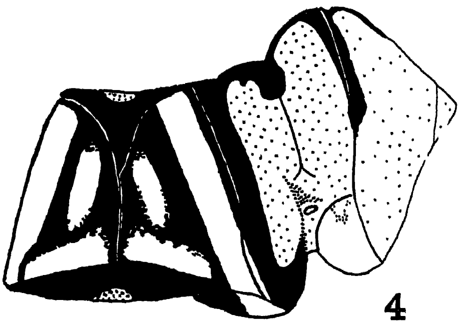
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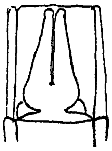
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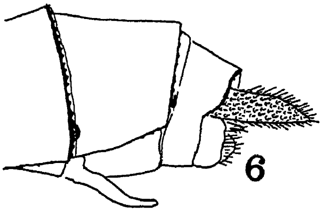
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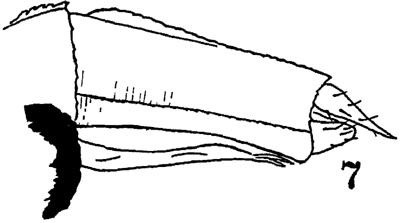
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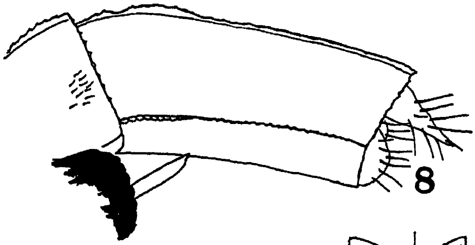
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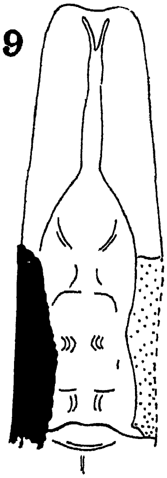
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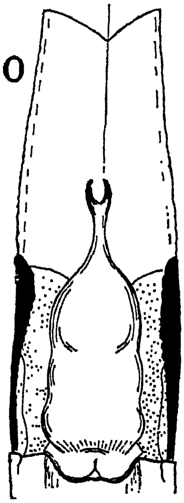
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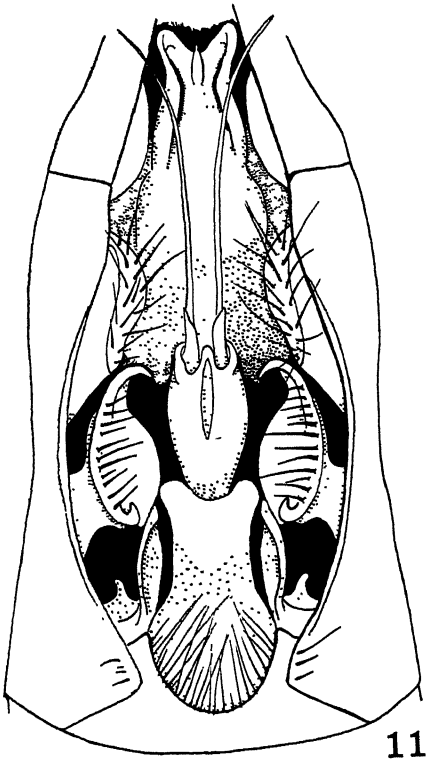
Fig. 1. *Oxygomphus chapini*, new species, terminal appendages, lateral aspect.
Fig. 2. Idem, terminal appendages, dorsal aspect.
Fig. 3. Idem, genitalia of the second abdominal segment, lateral aspect.
Fig. 4. Idem, diagram of thoracic color pattern.
Fig. 5. *Diaphlebia* species, vulvar scale, ventral aspect.
Fig. 6. Idem, vulvar scale, lateral aspect.
Fig. 7. *Phyllogomphus coloratus* Kimmins, vulvar scale and tenth segment, lateral aspect.
Fig. 8. *Phyllogomphus annulus*, new species, vulvar scale and tenth segment, lateral aspect.
Fig. 9. *Phyllogomphus coloratus* Kimmins, vulvar scale, ventral aspect.
Fig. 10. *Phyllogomphus annulus*, new species, vulvar scale, ventral aspect.



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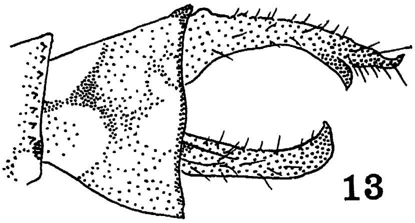

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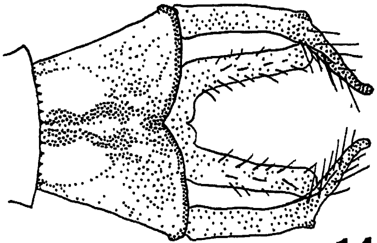

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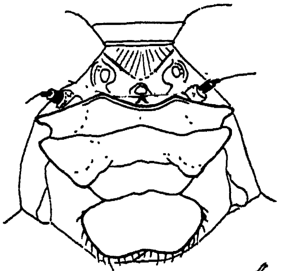

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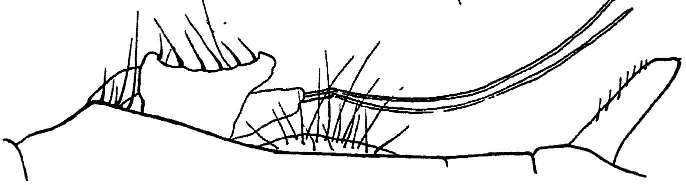

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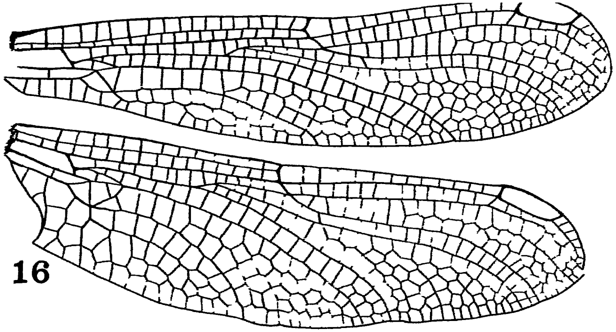
Fig. 11. *Peruviogomphus moyobambus*, new species, genitalia of second segment, ventral aspect.
Fig. 12. Idem, genitalia of second segment, lateral aspect.
Fig. 13. Idem, terminal appendages, lateral aspect.
Fig. 14. Idem, terminal appendages, dorsal aspect.
Fig. 15. Idem, face.



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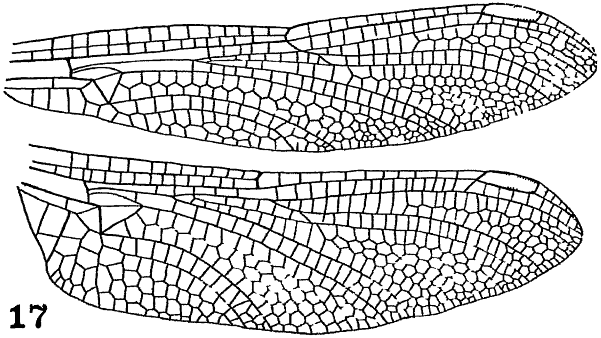

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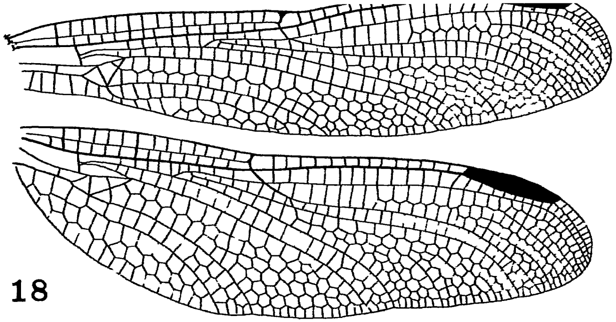
Fig. 16. *Peruviogomphus moyobambus*, new species.
Fig. 17. *Oxygomphus chapini*, new species.



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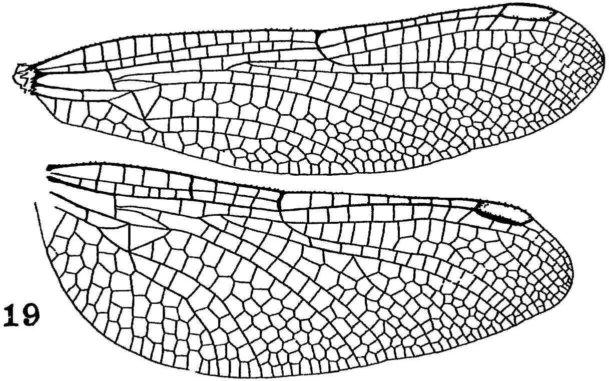

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Fig. 18. *Diaphlebia* species.
Fig. 19. *Notogomphus dorsalis* Selys.

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NOTES ON THE PROTODONATA AND PROTOZYGOPTERA OF THE LOWER PERMIAN OF KANSAS

BY ELSIE BROUGHTON KLOTS[1]

A collection of insects from the Permian beds at Elmo, Kansas, made in the summer of 1933 by Alexander B. Klots, V. S. L. Pate, and W. D. Sargent for Ward's Natural Science Establishment of Rochester, New York, included a few Protodonata and Protozygoptera. These, although few in number, were mute but conclusive evidence of the considerable degree of confusion which existed regarding the true nature of several of the species within that group. Through the courtesy and cooperation of Professor E. H. Sellards of the University of Texas, Dr. Carl O. Dunbar of the Peabody Museum at Yale University, and Dr. Reginald Painter of Kansas State College, I was able to make the comparisons that affirmed my suspicions that *Tupus permianus*, *Tupus readi*, *Kennedya mirabilis*, and *Progoneura minuta* had been incorrectly interpreted, and that those errors had been further enhanced by inaccurate drawings. Most of these errors have now been corrected (Carpenter, 1939), and new and helpful material has been described. I should like to add a few notes which I think are of value concerning my material.

The venational terminology employed by Carpenter is followed here. Mistakes may easily be made in translation from one system to another; one author, in his discussion of the genus *Tupus*, refers to his R_{4+5} (the R_3 of Tillyard and M_3 of Comstock-Needham) as R_3, as R_{3+4}, as R_5, and as R_{4+5}.

All the material mentioned in this paper except those specimens actually belonging to other people or institutions has been placed in the Department of Insects and Spiders, the American Museum of Natural History.

Tupus[2] **permianus** Sellards

It is to be recalled that when Sellards described this species (1906) he pointed out the presence of oblique veins at the fork of vein R_2 and R_3 (M_1 and M_2) and of a longitudinal intercalary or supplementary vein behind R_3. He compared these oblique veins with the *subnodal* and *oblique* veins of the Odonata and the intercalary sector with the *bridge* plus the *radial sector*. He considered their presence a substantiation of the Comstock-Needham theory of the crossing over of the radial sector and sufficient cause for making the Protodonata a subordinate group of the order Odonata. Tillyard (1925), upon examination of a photograph of *permianus* sent to him by Sellards, was unable to see any sign of the alleged oblique veins and restored the Protodonata to ordinal rank. Carpenter (1931) redescribed *permianus* from six specimens in the Harvard collection and from sketches and a photograph of the type. His drawing did not show the oblique veins, and we now know that he had no specimens with that portion of the wing preserved.

I think it is rather significant that of the six specimens I have seen of *Tupus* all show one or both of these veins present. Although the type of *permianus* remains lost we can feel confident that Sellards was correct in his description of this detail as he has been proved to be in the others.

I do not consider, as did Sellards, however, that their presence is a substantiation of the Comstock-Needham theory of the crossing over of the radial sector but rather that it has significant bearing on the refutation of that theory. It is hardly credible that, had the crossing over been accomplished and the proximal bracing by the bridge completed, portions of the strong radial sector would have occasionally dropped out, as seems to be the case in those of my specimens in which the subnodal is present and the oblique is missing (fig. 1); or that the trachea would follow the zigzag course indicated when the subnodal is well distal to the fork (figs. 2, 3). If we consider this material as dating from the period when the Protodonata were all unwittingly experimenting with various devices for support and increased wing efficiency and had yet to stumble upon or to evolve the nodal region of modern Odonata, how natural it would be to find the weak cross veins variable as to location in relation to the wing axis as well as in their actual presence or absence.

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[1] Finch Junior College, New York City.

[2] The genus *Tupus* was established by Sellards (1906, Amer. Jour. Sci., ser. 4, vol. 22, p. 249). In a note in that same journal for 1909, ser. 4, vol. 27, p. 151, in which he changes the name of several genera, he writes ". . . *Tupus* should read *Typus*." According to Articles 19 and 32 of the International Rules of Zoological Nomenclature (1926, Proc. Biol. Soc. Washington, vol. 39, pp. 35–104) the name should remain in its original form.

Fig. 1. Fragment, probably *Tupus*, showing "subnodal" vein at origin of vein R_3.

Tupus readi Carpenter

My collection includes two beautifully preserved portions and several small fragments which agree with the corrected description of *readi* (Carpenter, 1939). Since more of the wing area is shown than has hitherto been described, I include them here.

The large specimen (fig. 4) is 124 mm. in length. Precostal space short, extending but little beyond the second cross vein between C and Sc. C and Sc remote at the base, divergent to the level of the origin of R_s, then convergent towards the apex of the wing. Sc extending out on the wing well beyond the limits of the preserved portion. R_s+M forking from R_1 at a distance of 20 mm. from the base of the wing and one cell beyond the origin of MA. R_{4+5} originating at a distance of 48 mm. from the base of the wing or only about half as far from the base of R_s as from the origin of R_3 which is 101 mm. from the base of the wing. A sector between R_2 and R_3 rises six cells beyond the fork. An intercalary vein rising behind R_{2+3} at a point 86.5 mm. from the base of the wing is at first irregular, then in a few cells straightens out and becomes a strong convex vein paralleling R_{2+3} for a distance of about four cells, and then slightly diverges from it to run parallel to R_3. A strong oblique cross vein between R_1 and R_2 just after the origin of R_3 is in line with another oblique vein between R_3 and the intercalary vein. R_{4+5} is unbranched. Two cell rows between the intercalary vein and R_{4+5} at the level of the origin of R_3, the lower row slightly wider than the upper. MA and R_s at first divergent and then convergent toward the origin of R_{4+5}; MA then continues parallel to R_{4+5}. The first branch of MA rises 20 mm. or about 11 cells beyond the origin of R_{4+5}. Obsolescent base of Cu_1 present. Cu_2 unbranched, strongly undulate. Two oblique veins present between Cu_2 and A in the region of the anal crossing, slightly more than halfway from the base of the wing to the origin of 2d A; each of these oblique veins is considerably stronger than a normal cross vein. First A less strongly sigmoid than Cu_2, pectinately branched apically. Second A originating at the level of the origin of $Rs+M$. Anal angle of the wing angulate and characterized by the presence of greatly elongated cells extending from the anal vein to the wing margin for a distance of 10 cells.

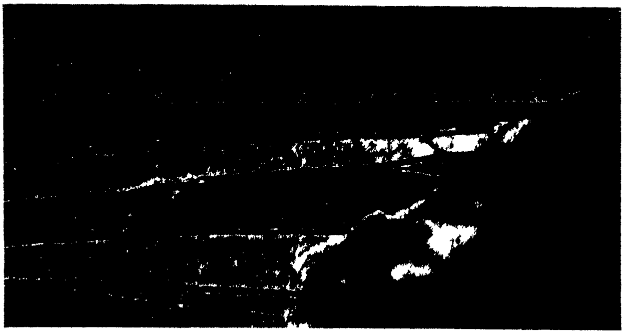

Fig. 2. Fragment, probably *Tupus*, showing "subnodal" vein beyond origin of vein R_3.

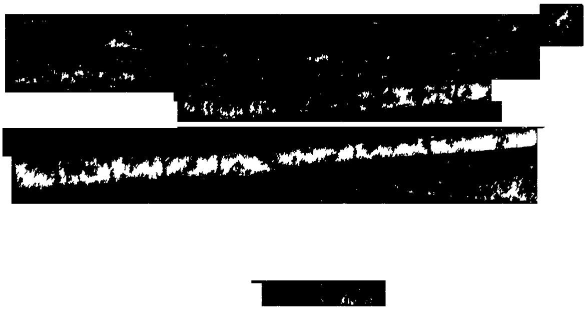

Fig. 3. *Tupus readi* Carpenter. Enlargement of portion of figure 4 showing "subnodal" and "oblique" veins beyond the origin of R_3.

My specimens differ from Carpenter's corrected figure of *readi* only in the presence of the oblique veins at the origin of R_3 (fig. 4), in the slightly more proximal position of R_{4+5}, and in the presence of the oblique veins in the region of the anal crossing.

Another specimen (fig. 5) in this collection, measuring 111 mm., is larger. The "subnodal" vein is present and is two and a half cells before the origin of R_3, but the "oblique" is not present. The space between the origin of R_3 and the vein R_{4+5} is greater than in the other material due to the unusual height of the cell row just above R_{4+5}. The first branch of MA rises nearer the level of the origin of R_{4+5}, the two being 11 mm. or eight cells apart. The relation of 2d A with the parallel veins on either side is more like *Tupus* at the level of the fork of R_{4+5} than it is like *Megatypus*. But now that we know of the error in the definition of *Megatypus* in regard to the supposed distal origin of R_{4+5}, it is difficult to distinguish between these two genera when only this area of the wing is available.

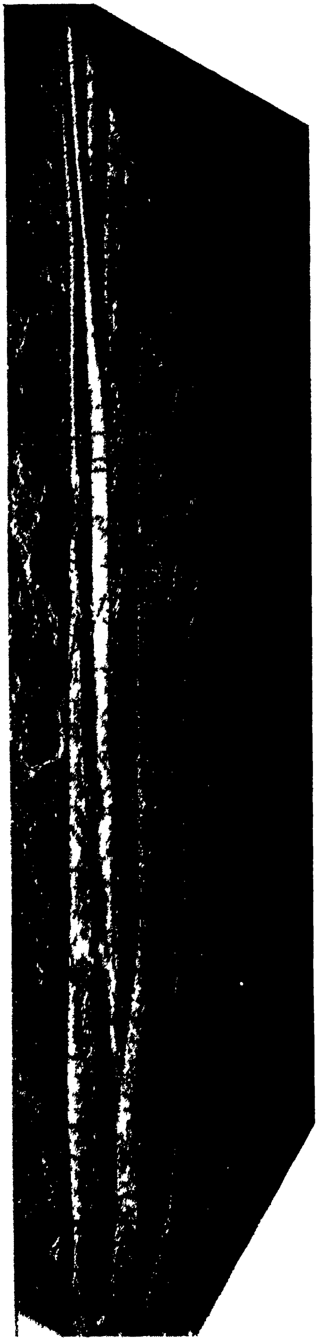

Fig. 4. *Tupus readi* Carpenter.

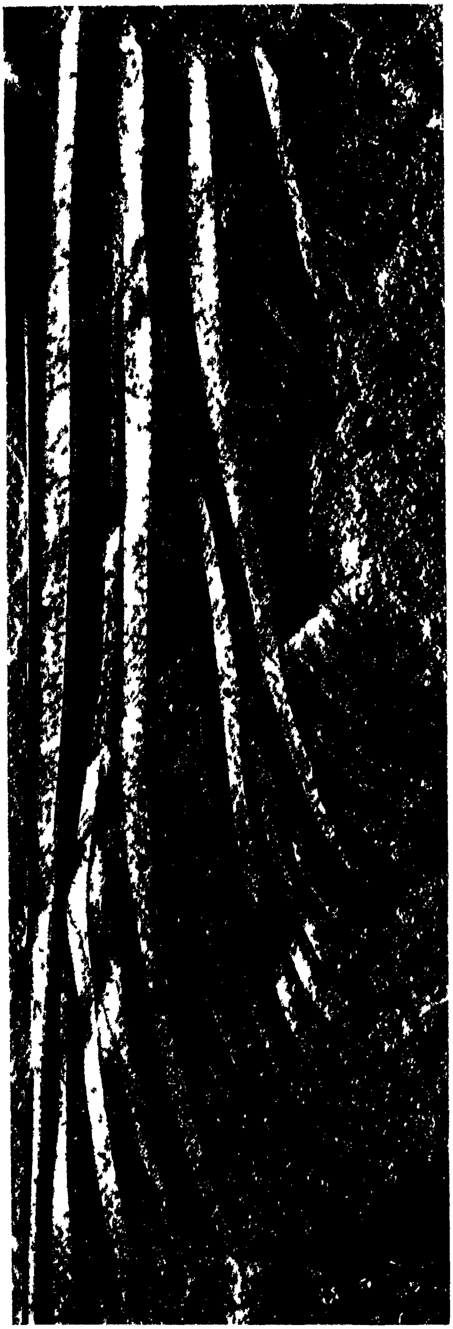

Fig. 5. *Tupus readi* Carpenter.

In the collection of the Kansas State College at Manhattan, Kansas, there is a fine wing collected by J. W. McCulloch which is also of this species. It is slightly smaller than the type. The first branch of MA rises 10 mm. or seven cells beyond the origin of R_{4+5}.

These three specimens differ from the type in size, but the difference is not inconsistent with individual variation. That portion of the wing extending from the apex of the second arch of Cu_2 to the origin of R_3 (taken because it is the only portion comparable in the four specimens) measures, respectively, 52, 66, and 43 mm.

The specimens that I have seen of *T. readi* do not show the hooking of the vein tips which is so conspicuous in the photograph of the type of *permianus* sent to me by Sellards. The drawing of *M. vetustus* (Carpenter, 1933, p. 416), later identified as *permianus* (Carpenter, 1939), does not show it either, but this may be the artist's error.

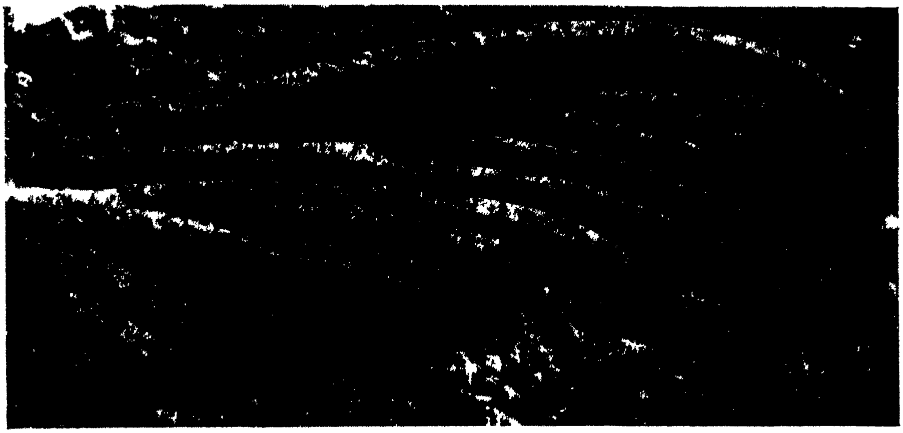

Fig. 6. *Oligotypus tillyardi* Carpenter.

Oligotypus tillyardi Carpenter

One of my specimens, measuring 24 mm. from the origin of R_{4+5} to the apex of the wing, is probably of this species (fig. 6). The apex is considerably more rounded than that shown in the figure of the type (Carpenter, 1931, p. 107). Vein R_2 follows the curve of the wing tip and arches strongly downward. Sc fuses with the costa before the origin of R_{4+5}. Vein R_1 approaches the costa rather abruptly about one-third of the way between the origin of R_{4+5} and the apex of the wing, and from that point vein C seems to form a thickened cord-like border to the wing. This thickening may be due to a folding under of the wing margin, but its ridge-like quality makes that seem unlikely. An oblique cross vein lies between veins R_1 and R_{2+3} at a point about halfway between the approximation of R_1 and C and the apex of the wing. The recurrence of another oblique vein, though a not particularly strong one, between R_{2+3} and the intercalary sector behind it makes one wonder if this is an experiment in bracing comparable to that which may be indicated by the subnodal and oblique veins of *Tupus*.

Kennedya mirabilis Tillyard

The drawing that accompanies the original description of the type of this species (Tillyard, 1925, p. 64, fig. 10) differs slightly from the photograph of the same specimen published in the same article (p. 67, fig. 12A). A second and composite drawing published later (Tillyard, 1928, p. 163, fig. 6) shows still greater dissimilarity to the photograph. A copy of this second drawing (Carpenter, 1931, p. 117, fig. 4) has further increased the discrepancies and has created a misunderstanding regarding the true nature of the genus. A more recent drawing (Carpenter, 1939, p. 46) is more accurate.

I have examined the type of *Kennedya mirabilis*, Specimen No. 5006 a-b, in the Yale University collection and wish to emphasize the following facts regarding it. Veins Sc and C converge at equal obliquities to form the nodus, as described by Tillyard, but do not make a distinct break in the costa as his and subsequent drawings indicate. Vein R_1 curves slightly upward at its origin, although viewed from some angles this upward bend is imperceptible. Rs originates more than halfway down on the arculus and arches upward at its origin rather more abruptly than figured hitherto. MA is deflected at the point of the cross vein m-cu and does not follow the curve of the arculus. Cu_2 does not follow a straight course through the petiole but is slightly undulate. First A rises at the apex of the undulation of Cu_2 and diverges from it gradually, forming a long, triangular subquadrangle with anterior and posterior sides curved as described by Tillyard.

A specimen in my collection having the preserved portion of the wing measuring 29 mm. (fig. 7) is somewhat smaller than the type, for a portion measuring 25.6 mm. in the type is but 18 mm. long in this specimen. It agrees with the type except that the costa is more nearly straight and that vein Rs is slightly less arched at its origin.

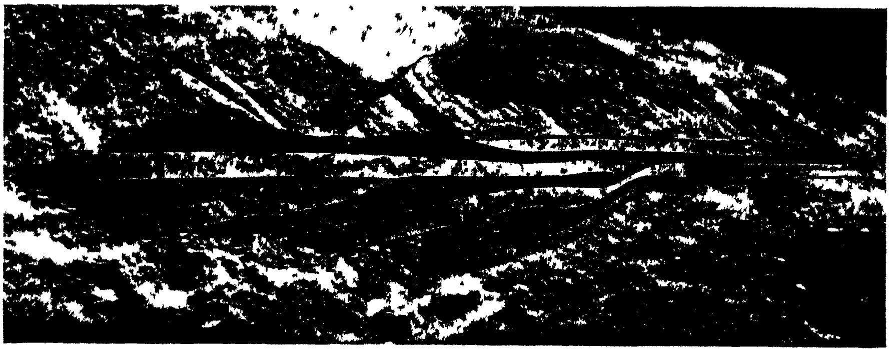

Fig. 7. *Kennedya.*

Kennedya (Progoneura) minuta Carpenter

Kennedya mirabilis and *Progoneura minuta* are distinguished by characters of degree and not of difference, and I believe that they can no longer be considered as of separate genera. The costa of *minuta* is straight at the nodus, the costa of the type of *mirabilis* is less broken than the author of *minuta* believed it to be, and in the specimen of *mirabilis* in my collection it is even more like that of *minuta*. Vein R_1 in *minuta* is almost straight at its origin; in *mirabilis* it curves but slightly and at some angles appears to be straight. Vein Rs in the type of *minuta* is nearly straight at its origin and rises at the middle of the arculus. This I had thought to be a true difference between the two species, but Carpenter has a new specimen of *minuta* (1939) which shows the location and manner of origin of Rs to be nearly identical with that of *mirabilis*. The deflection of MA, the undulation of Cu_2 within the petiole, and the shape of the subquadrangle are seen now to be similar also.

There is in my collection a specimen (fig. 8) which I had determined as *minuta* because of its small size. The preserved portion of the wing measures 16 mm., while the corresponding portion of the larger wing described above as *mirabilis* measures 26 mm. But Carpenter (1939) has now shown that size is not a criterion. This leaves only the length of 1st A as a point of difference between them. In *mirabilis*, 1st A surmounts five and one-half cells (Carpenter, 1939) beyond the quadrangle, and in *minuta* it surmounts only one cell. This seems like a significant difference, until we find that *K. tillyardi* has been described (Carpenter, 1939) as having 1st A surmounting three and one-half cells, that my larger specimen (fig. 7) has it surmounting two and one-half cells, and that my smaller one (fig. 8) has it surmounting one and one-half cells. It remains, then, to determine whether *mirabilis* and *minuta* are the same or whether each of the known specimens should be described as a separate species.

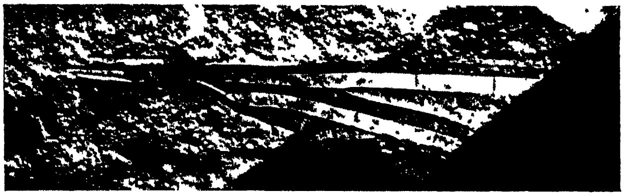

Fig. 8. *Kennedya.*

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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 51

BEHAVIOR AND ECOLOGICAL NOTES ON SOME ANTS FROM SOUTH-CENTRAL FLORIDA[1]

BY T. C. SCHNEIRLA

The present report contains some records of observations made during late August and early September, 1943, at the Archbold Biological Station, Florida, which is situated in the lower portion of the Highlands Ridge area of Florida, about midway between Lake Okeechobee and Arcadia.[2]

About 65 species of ants were taken, including two new to science which are being described by M. R. Smith (1944), and some others new to the Florida list.[3] This paper is concerned with a few of these species for which the notes appear to be of special interest.

Formica pallidefulva archboldi M. R. Smith

Single foragers of this dark chocolate-brown *Formica* were captured frequently near the border of ponds or swampy areas, usually running on vegetation. (It is notable that the nests of *F. archboldi* are found in low ground, near bodies of water. No cases were observed in the higher sandy terrain frequented by the other *F. pallidefulva* subspecies.) The ant was particularly difficult to capture, not only because of its speed and capacity to spurt and change direction suddenly in running, but also because of the readiness with which it fell or actually jumped from heights when startled.

At length a nest of *F. archboldi* was found about 6 feet from the edge of a swamp, in an open sandy space surrounded by palmettos and low bushes. The entrance (located by tracing foragers to the nest from various points within a radius of 100 feet from the nest entrance) lay under a clump of grass. Three galleries descended close together from a shallow surface chamber covered by a canopy of detritus supported by plant stems. The nest, which was excavated in its entirety, was restricted to an area not more than 12 inches in diameter and 7 inches deep. Its numerous galleries and chambers were closely arranged within this space and extended nearly to the water level, which was 8 inches below the surface. The entire nest lay closely above a dead palmetto root and around its central portion, in moist sandy loam permeated by fine rootlets.

The colony was isolated by digging a trench around the nest and, after ascertaining the absence of lateral galleries beyond the central area about 1 foot in diameter, the block of earth was removed to the laboratory for examination. During a period of about one hour, while the digging was in progress, 37 ants returned to the nest from various directions, some carrying parts of insects or whole carcasses, others empty or replete with nectar, others evidently unladen. Since numerous others engaged in foraging at the time remained uncaptured, the population count represents merely a rough census. In all, one queen, 1210 adult workers, and 414 brood were taken from this colony. About two-thirds of the brood were in various stages of pupation, only a small proportion of it enclosed in cocoons. There were a few packets of eggs and numerous immature larvae, not counted.

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[1] A contribution of the Department of Animal Behavior, the American Museum of Natural History.

[2] Mr. Richard Archbold (Research Associate in the Department of Mammals, the American Museum of Natural History), who maintains the station, has made its facilities available to the scientific staff of the American Museum. The writer is grateful to Mr. Archbold for his hospitality and his kindness in facilitating the present study in every possible way.

[3] [illegible] ants described in the present paper were determined by Dr. Smith.

Around the outskirts of the close system of galleries and chambers which comprised the *Formica* nest, on all sides near the surface, were nests of *Solenopsis pergandei.* Five separate colonies were found, each with numerous queens and a large brood. These evidently were present as "thief ants," for their small galleries could be traced to connections with the larger *Formica* tunnels. When the earth was broken the tiny *Solenopsis* swarmed upon the *Formica* in numbers, biting and stinging the larger ants.

The *F. archboldi* colony was installed in an artificial nest and is still on hand in good condition. Unfortunately the queen was killed by a small group of her own workers when she was placed with them after a month of isolation in a vial.

Formica pallidefulva Latreille

Colonies of this ant were found at points widely apart in upper sandy areas of palmetto scrub and pine. The light-brown workers make their way surprisingly well as individual foragers. Orientation tests showed that solitary ants can pursue direct routes over fairly long distances, dependent upon special cues such as the visual effect of a single tree or group of trees. Thus foragers were able to continue passing directly across an open area 12 yards wide among palmettos, even after the sand was thoroughly stirred around or removed to a depth of 4 to 6 inches, but in various tests they circled about, obviously disoriented, when a large black sheet was placed so that it masked a pine tree standing at one side of the distant nest. The movements of these ants in foraging are strikingly speedy and vivacious. At times their progress across an area covered by pine needles is so rapid that it can be followed only very uncertainly, and often appears to involve a series of small leaps or skips from needle to needle. When attempts are made to capture an ant by hand the ability to spring from an elevated surface is clearly in evidence, and together with exceedingly rapid running makes the foragers very elusive. When a series of them was placed in a quart glass jar and the ants were permitted to escape successively as an orientation test, most of the subjects were able to leave the top of the jar on the side toward which they were progressing when captured, and almost all of them reached the ground by leaping out from the rim or shoulder of the container to a landing spot a few inches from the base. There can be little doubt that these ants are capable of "jumping."

Furthermore, at times the foragers were observed *dropping* to the ground from grass blades or even from the stems of bushes. To test this behavior, a laboratory set-up was prepared in which the *Formica* could reach a food card only by dropping to it from a point about 10 inches overhead. After an introductory feeding on the floor, the ants appeared in numbers, many of them soon reached the ceiling of the glass cage, and shortly some of them were dropping. At first they dropped rather randomly, from remote places as frequently as from places directly above the food card. However, a distinct improvement was observed, even in the course of an hour or two during the first session. Although the first falls seemed to occur accidentally, as a result of losing hold while running upside down on the glass, within 10 or more trips a more definite pattern of behavior appeared in certain individuals. These ants typically ran in increasingly narrower circles on the ceiling, with occasional stops to extend downward by releasing the anterior pairs of legs, at length hanging down with only the rear legs holding. From the last vertically extended position the ant might pull back abruptly and resume its running, to repeat the act somewhere else or, after swaying briefly, might fall to the food card or floor. Some of them improved in the ability to hit the food card, so that their misses decreased noticeably within a series of 30 or more trips. In various tests evidence was obtained suggesting that the ants dropped more readily the more the stimulus card (a disk hiding the food) contrasted visually with the white floor, also that a discrimination somehow depending upon the "area" (or brightness, etc.) of the stimulus disk could develop. These preliminary findings suggest the development of a specialized dropping response related to a visual discrimination, an apparent learned adjustment which merits further investigation.

Two nests of *F. pallidefulva* were excavated in their entirety, from points about one-third of a mile apart in a sandy palmetto scrub area containing pines. One nest lay well within the area of a "dry pond," in a dense growth of grass and reeds, the other in light sandy loam among palmettos. Each nest was restricted to a small space not more than 10 inches in diameter, and both had their excavations entirely in an upper area of sandy loam topsoil without entering the pure sand below. Within this relatively small nesting space the numerous galleries and chambers of the nest were confined very closely, without any trace of the ramifications which characterize the nests of *F. pallidefulva* in northern areas. The same fact held for two other *F. pallidefulva* nests excavated in part, and for the *F. archboldi* nest which was completely excavated.

All four of the *F. pallidefulva* nests examined were hidden below clumps of grass, reeds, or surface rubble. The actual entrances were difficult to locate because of the variety of ways in which foraging ants departed from and reëntered the immediate environs of the nest. Characteristically, the two or three entrance holes of a given nest lay within a 3 to 4 inch wide area which was covered by a thin canopy composed of particles of earth and bits of vegetation. This canopy covered a shallow entrance chamber, above which it was supported by numerous grass and plant stems. This feature of nest building resembles the canopies formed by other camponotine ants such as *Lasius* in Europe (e.g., Pickles, 1942).

A census was made of the two colonies mentioned above. Colony A was isolated in the early morning before foraging had begun, hence the count may be considered complete; colony B was isolated in the late afternoon when foraging was in progress, hence was not completely counted. The results are given in table 1. In both cases unhatched and newly hatched eggs were present, but since many were lost in removing the ants no counts are given.

TABLE 1

POPULATION OF TWO COLONIES OF *F. pallidefulva* EXCAVATED AT THE ARCHBOLD BIOLOGICAL STATION, FLORIDA

	Adult individuals		Pupae		Larvae	
	Queens	Workers	Advanced	Immature	Advanced	Immature
Colony A (Aug. 17)	1	507 (14 callows)	71 (30 enclosed, 41 naked)	105	13	20
Total	508 adult individuals; 209 brood.					
Colony B (Sept. 5)	1	647	87 (22 enclosed, 65 naked)	83	17	21
Total	648 adult individuals; 208 brood.					

It is a notable fact that, although the three *Formica* colonies studied were all fairly large, their nests were located only with difficulty by a slow process of tracing back foragers from food cards placed in the vicinity. Attempts were made to find other nests by tracking foragers but without success, a testimonial to the inconspicuous nest sites of the species in this area.

Camponotus abdominalis floridanus (Buckley)

This ant is one of the most successfully and widely adapted of all in the region, with very numerous nests in a variety of situations ranging from pine stands on the sand hills to low open areas near bogs and ponds. During August and September, I found many flourishing colonies of thousands of workers and large broods under empty "dust sacks" which had been thrown away by orange growers, in orchards, on roads, and in a variety of other situations. Perhaps more than three-fourths of these heavy paper sacks covered ant colonies, virtually always *C. floridanus*, and most of them were in the vicinity of orange groves. It is very possible that the insect prey of these ants includes species which are injurious to orange trees or fruit, and that the inadvertent encouragement of *C. floridanus* thus may be quite incidentally a great source of benefit to the orange crop. If that is the case, the abandon with which the orchardists scatter their dust sacks about the countryside offers another illustration of the bizarre relationships (in this instance a favorable one) frequently noticed between planter's behavior and crop ecology.

A striking peculiarity of behavior characterizes the responses of this ant to sudden environmental change. When disturbed, as by the sudden uncovering of their nest, *floridanus* workers typically begin an erratic, spastic activity marked by irregular or circular running, frequent stops and short jerky advances, and a "nervous" trembling of the entire body. This "jittery" behavior continues even while the brood is being carried away, when masses of workers are involved and details are indistinguishable amid a seemingly hopeless confusion. This behavior is not to be confused with the rapid erratic type of locomotion which characterizes the regular field behavior of *Dorymyrmex pyramicus*, *Iridomyrmex pruinosus*, and numerous other Florida (and tropical) ants, a pattern which may be attributed mainly to temperature (since it is largely absent when the temperature falls to about 80° F.). In the laboratory at 75° F., "heat activity" is greatly reduced, but the "nervous" response of *C. floridanus* workers to disturbances continues. It may be elicited readily at almost any time in each of several small colonies which I have raised in the laboratory as the progeny of queens taken after marriage flights in September. The "jittery" behavior appears almost invariably when the glass covers of the small nests are raised, even after daily repetition of the test during several months in the laboratory. If a worker chances to begin feeding during a seizure, the activity is reduced to a general trembling of the body with or without a rapid beating of raised front legs, but at such times feeding is likely to be discontinuous. Similarly the amplitude of the movements is reduced when larvae or eggs are picked up during a "seizure," although trembling continues and locomotion is erratic. An interesting fact is that among eight *floridanus* queens (which have raised young colonies in the laboratory), six have not exhibited the above pattern of behavior under any conditions during several months of daily observation, one shows it occasionally and partially, and only one queen regularly and definitely exhibits the characteristic excitatory pattern of the worker.

ASSOCIATED COLONIES

In low marshy or boggy ground the partially decayed standing stumps or hulks of pines frequently contain interesting associations of numerous colonies of various ant species, together with termites. As an example, one variegated assemblage of this kind was found within a pine hulk standing inside the border of a shallow pond, surrounded by water but only a few feet from the bank. Within this one dead tree trunk, in very close proximity to one another or with galleries actually interdigitating, nests of the following species of ants were found:

Solenopsis geminata rufa (Jerdon)
Iridomyrmex pruinosus (Roger)
Euponera (Trachymesopus) stigma (Fabricius)
Solenopsis globularia littoralis (Creighton)
Campanotus abdominalis floridanus (Buckley)

In addition, there were termites (sp. ?). The *Iridomyrmex* and *Solenopsis* colonies were large but more or less localized; the *Euponera* colony was very large and extended widely around the trunk; the *Camponotus* colony, also large, was confined to one side. In a similar heterogeneous association of species in another stump, the tiny *Brachymyrmex heeri depilis* was found, evidently in a cleptobiotic relationship (Wheeler, 1901) with a large colony of *Euponera stigma*. In other instances, in addition to those already described, other species were discovered in stump associations, including, for example, *Aphaenogaster macrospina* M. R. Smith and *Paratrechina* (*Nylanderia*) spp.

These associations of colonies of numerous species were regularly found, as described, in tree hulks surrounded by, or close to, water. The concentrically juxtaposed or commingled galleries of the various colonies usually were well developed, and the large populations had the appearance of having been established for some time. It would be interesting to know how such a vast heterogeneous assemblage of ants is able to get the necessary food to weather the long summer period of rains during which the dead stumps housing them are cut off from dry land. The extent to which they may have become adjusted biologically or behaviorally to one another also is a matter of interest.

The described multi-species aggregations seem to fall largely under the Wasmann (1891) heading of accidental (i.e., occasional) forms of "compound nests," a condition termed by Wheeler (1901) "plesiobiosis." However, until live colonies can be collected and their inter-colony relationships can be studied under laboratory conditions, the degree to which an accidental or a regular (i.e., incipient) symbiosis may be involved in these interesting assemblages is a matter of speculation.

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STUDIES OF PERUVIAN BIRDS. NO. XLVIII[1]

THE GENERA *IRIDOSORNIS, DELOTHRAUPIS, ANISOGNATHUS, BUTHRAUPIS, COMPSOCOMA, DUBUSIA,* AND *THRAUPIS*

BY JOHN T. ZIMMER

Many thanks are due to Messrs. James Bond and Rodolphe de Schauensee of the Academy of Natural Sciences of Philadelphia, Mr. W. E. C. Todd of the Carnegie Museum of Pittsburgh, and Acting Director Orr Goodson, Mr. K. P. Schmidt, and Mrs. Ellen T. Smith of the Chicago Natural History Museum for the loan of important material in their charge that has been of much service in the following studies.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

Iridosornis rufi-vertex reinhardti (Sclater)

Iridornis reinhardti SCLATER, 1865, Ibis, new ser., vol. 1, p. 495, pl. 11—eastern slope of the Peruvian cordillera; Copenhagen Mus.

Two birds from San Pedro, near Chachapoyas, extend the known range of this form slightly to the northward. I can find no characters distinguishing these specimens from those taken farther south.

I agree with Hellmayr that the characters shared in common with *rufi-vertex* outweigh those which separate it, and that the relationship may best be expressed by the use of a trinomial. The yellow area on the top of the head is paler than in *rufi-vertex* and is withdrawn from the crown but extended laterally to the sides of the neck and the posterior part of the auriculars. The lack of rufous on the lower under parts is shared by *I. r. caeruleoventris*. The coloration of the rest of the plumage and the proportions are shared by all the subspecies.

Records of *reinhardti* are from Culumachay, Puyas-yacu, Pumamarca, and Cumpang (Compan).

In the examination of the various forms of this species, an interesting situation has come to light. The original description of *I. r. ignicapillus* from southwestern Colombia pointed out the deeper, more orange hue of the coronal patch in comparison with typical *rufi-vertex* from eastern Colombia, but overlooked the fact that *ignicapillus* has, rather consistently, a broader black frontal band. In *rufi-vertex*, this band varies in width (along the median line from the exposed base of the culmen to the posterior border) usually from 4 to 6 mm.; in one specimen it is only 3.5, in one it is 7 and in one 8 mm. The average of 21 specimens is 5.4 mm. In *ignicapillus*, the band is 6.2–8 mm. wide, averaging 7.3 mm.

Birds from the western side of the Western Andes in Ecuador have the frontal band even wider, on occasion, but show the coronal patch varying from the light yellow of *rufi-vertex* to a darker and duller tone, though still without the strong orange hue of *ignicapillus*. Since these birds cannot be referred either to *rufi-vertex* or *ignicapillus*, it seems desirable to give them a new name as follows.

Iridosornis rufi-vertex subsimilis, new subspecies

TYPE: From Mindo Valley, western Ecuador; altitude 9400 feet. No. 173618, American Museum of Natural History.

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[1] Earlier papers in this series comprise American Museum Novitates nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, 917, 930, 962, 963, 994, 1042, 1043, 1044, 1045, 1066, 1095, 1108, 1109, 1126, 1127, 1159, 1160, 1168, 1193, 1203, 1225, 1245, and 1246.

Adult male collected September 4, 1922, by Chapman, Cherrie, and O'Connell.

DIAGNOSIS: Similar to *I. r. ignicapillus* of southwestern Colombia in respect to the broad frontal band, averaging even wider, but differing from it by the color of the coronal patch which lacks the strong orange tone, being lighter or duller. In the light extreme, the color of this patch matches that of some examples of *rufi-capillus*, but the frontal band is broader than in that form.

RANGE: Western slope of the Western Andes of Ecuador.

DESCRIPTION OF TYPE: Whole head and neck black except for the bright coronal patch, with the frontal band broad, extending posteriad 9 mm. in mid-line from the exposed base of the culmen; center of crown, occiput, and nape occupied by a broad patch of Xanthine Orange, leaving a broad black collar behind it on the hind neck; mantle a little more violaceous than Hay's Blue; lower back and upper tail-coverts Dusky Blue × Indulin Blue. Breast (behind the black throat) near Azurite Blue; lower breast and flanks a little darker than the lower back; belly and under tail-coverts Auburn × Sanford's Brown. Remiges blackish; primaries, except outermost, with only a faint trace of bluish color on the outer margin; secondaries and tertials with broad outer margins near China Blue; greater upper wing-coverts margined like the secondaries; middle and lesser series a little brighter blue than the mantle; primary-coverts black with slightly stronger bluish outer margins than the primaries, under wing-coverts sooty, with traces of bright brown on the tips of the lower series, only faintly paler than the rest of the under side of the webs. Rectrices blackish, with outer margins near Dark Cadet Blue. Bill (in dried skin) blackish, with the mandible a little slaty; feet dark brown. Wing, 87.2 mm.; tail, 74.5; exposed culmen, 9.2; culmen from base, 13; tarsus, 26.

REMARKS: Females like the males but a little smaller, at least averaging so; wing, 79–82.1 mm. (as against 80–87); tail, 64–66 (as against 66–74.5).

The type is one of the darker-crowned examples of the new form, but from this extreme there is a gradation of color on the area in question reaching a pale yellow extreme that is close to Deep Chrome. In *ignicapillus*, the color is a little more reddish than Orange Chrome. In *rufi-vertex*, it is nearer Cadmium Yellow or Orange.

Although the characters of this form are composed of a combination of certain features of *rufi-vertex* and *ignicapillus*, they are not intermediate between them. In the matter of the frontal band, *subsimilis* is even more marked than *ignicapillus*, having its width ranging from 7 to 11 mm., averaging 8.3. As noted above, the color of this cap also is not an intermediate hue but is duller than in either of the others.

SPECIMENS EXAMINED

I. r. rufi-vertex.—
  COLOMBIA:
    El Piñón, 1 ♂;
    "Bogotá," 4 (?).
  ECUADOR:
    Oyacachi, 2 ♂, 4 ♀;
    Macas region, 1 (?);
    Zuñac, 3 (?);
    Tambillo, 2 (?);
    Asilan, 1 (?);
    Galgalan, 1 (?);
    "S. Ecuador," 1 (?).
I. r. caeruleoventris.—
  COLOMBIA:
    Paramillo, 2 ♀ (incl. type).
I. r. ignicapillus.—
  COLOMBIA:
    Coast range west of Popayan, 3 ♂ (incl. type), 3 ♀;
    Almaguer, 2 ♂;
    "Antioquia," 1 (?).
I. r. subsimilis.—
  ECUADOR:
    Mindo Valley, 1 ♂ (type);
    Mindo, 1 ♂;
    Gualea, 1 ♂, 2 ♀;
    Nono, 2 (?);
    Aloag, 1 ♀;
    above Intac, 2 ♂;
    Verdecocha, 1 ♂, 1 ♀;
    west side of Pichincha, 1 ♀;
    "Quito-skin," 1 (?);
    "Chivinda" (*ex* Buckley), 1 ♂.
I. r. reinhardti.—
  PERÚ:
    San Pedro, 1 ♂, 1 ♀;
    Rumicruz, 1 ♂, 1 ♀, 1 (?);
    Maraynioc, 2 ♀;
    Cueva Seca, 1 (?).

Iridosornis jelskii jelskii (Cabanis)

Iridornis Jelskii CABANIS, 1873, Jour. für Ornith., vol. 21, p. 316—Maraynioc, Perú; ♂; Berlin Mus.

Apparently never found anywhere in Perú except at Maraynioc, from which locality we have a number of specimens. The record from the Urubamba Valley is better assigned to the following form.

Iridosornis jelskii bolivianus Berlepsch

Iridosornis jelskii boliviana BERLEPSCH, 1912 (Feb.), Ber. V Internatl. Ornith. Kongr., Berlin, 1910, p. 1043—Unduavi, La Paz, Bolivia; ♂; Frankfort Mus.

The two males from Cedrobamba, near Machu Picchu, recorded by Chapman (1921, Bull. U. S. Natl. Mus., vol. 117, p. 119) are closer to the Bolivian subspecies than to typical *jelskii*, although they are not so strongly marked as a female from Cocopunco, La Paz. The Cocopunco bird has only the faintest trace of yellow tips on the black feathers of the median line of the forehead—not noticeable except on close examination—and those on the anterior part of the crown are less prominent than in *jelskii*. In the Cedrobamba birds, the marking on the forehead is only slightly more pronounced but still weaker than in the Maraynioc examples. The correspondingly greater extension of the black pigmentation is further demonstrated in all three birds over the rest of the top of the head where the dark centers of the feathers are somewhat deeper black than in *jelskii* and reach nearer to the tips of the feathers. An additional character also is shown by all three specimens, although I can find no mention of it in discussions of *bolivianus*. This is the color of the mantle which is nearer an indigo hue than the more violaceous blue of the same area in *jelskii* (near dark Eton Blue instead of Deep Dull Violaceous Blue).

Although *bolivianus* might be expected to occur in extreme southeastern Perú adjacent to Bolivia, there are no records of the species from that region.

SPECIMENS EXAMINED

I. j. jelskii.—
  PERÚ:
    Maraynioc, 6 ♂, 4 ♀, 1 ♀[1].

I. j. bolivianus.—
  PERÚ:
    Cedrobamba, 1 ♂, 1 ♂[1].
  BOLIVIA:
    Cocopunco, 1 ♀.

Iridosornis analis analis (Tschudi)

T[anagra] analis TSCHUDI, 1844 (May), Arch Naturgesch., vol. 10, no. 1, p. 287—Perú; Lima (*errore*), Tschudi, 1846; C. Perú suggested, Berlepsch, 1912; Vitoc suggested, Hellmayr, 1936; cotypes in Mus. Neuchâtel, U. S. National Mus., and British Mus.

A male of this form from Cutucú, eastern Ecuador, extends the known range well to the northward, approaching somewhat closer to that of the allied *I. a. porphyrocephalus*. A specimen of the latter from Buckley's collection through the Boucard Museum is labeled "Sarayacu" where it is known that Buckley worked, but the only indication of locality is on the Boucard Museum label, and the word "Sarayacu" has been added to the label after the rest of the lettering which gives, simply, "Aequator." The specimen is of regular "Quito" preparation. The only definite Ecuadorian locality for *porphyrocephalus* is above Intac, on the western side of the Andes, although other "Quito" skins are known, one of which also is at hand. There is, thus, no near conflict of the ranges of *porphyrocephalus* and *analis*.

As in the case of other members of the genus *Iridosornis* (*reinhardti* and the *rufi-vertex* group), the subspecific distinction appears to be quite abrupt, but there are more points of resemblance than of difference. Among the similarities may be mentioned the pattern of pigmentation of the bill, common to *analis* and *porphyrocephalus* but not shared with the other conspecies.

I can see no distinctions in the series of *analis analis* from eastern Ecuador to southeastern Perú. Two birds from the Huayabamba Valley show some development of red on portions of the yellow throat, quite marked in one of them.

Friedmann and Deignan (1942, Zoologica, vol. 27, p. 52) consider one of Tschudi's specimens in the United States National Museum as a cotype of *analis*, basing this contention on the fact that Tschudi did not specify any particular specimen as type in his published accounts of the species. There is no evidence, either, that Tschudi marked any of his birds as type, even without publishing that fact. In Berlepsch and Hellmayr's account of a limited number of Tschudi's birds in the Neuchâtel Museum (1905, Jour. für Ornith., vol. 53, pp. 6–20), the transcriptions of the labels there given show no such designation. Consequently, Friedmann and Deignan are probably correct in their contention. Another cotype is in the British Museum.

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[1] Specimens in U. S. National Museum, Washington, D. C.

There is no justification for the claim that other specimens in the United States National Museum are types of Tschudi's species merely because Berlepsch and Hellmayr failed to mention those species in their paper. They expressly state that their discussion concerns only certain forms which are poorly known. Most of Tschudi's birds are thus left out of the account, although the types, or perhaps cotypes, of these were in the Neuchâtel Museum at the time and are still there. Without other evidence, therefore, I must consider the specimens in the United States National Museum as no more than cotypes at best.

Records of *analis* are from Achamal, Chirimoto, Pampa de Felipe, Ray-urmana, Utcubamba, Huaynapata, and San Antonio. Tschudi's citation of "Lima" is totally unsupported by any later evidence and must be considered erroneous.

SPECIMENS EXAMINED

I. a. analis.—
  PERÚ:
    Inca Mine, 2 ♂;
    Santo Domingo, 6 ♂, 3 ♀;
    Río Inambari, 4 ♂, 1 ♀;
    Idma, 2 ♂;
    Chilpes, 3 ♂, 4 ♀;
    Utcuyacu, 2 ♀;
    Garita del Sol, Vitoc, 1 ♂;
    Chinchao, 1 ♂[1], 3 ♀[1];
    Huachipa, 1 ♂[1];
    Chachapoyas, 1 ♂;
    Huayabamba [Valley], 1 ♂, 1 ♀.
  ECUADOR:
    Cutucú, 1 ♂.

I. a. porphyrocephalus.—
  ECUADOR:
    "Sarayacu" = "Quito-skin," 1 (?);
    "Quito," 1 ♂.
  COLOMBIA:
    Cerro Munchique, 1 ♀;
    Nóvita trail, 1 ♂;
    Cocal, 2 ♂;
    San Antonio, 4 ♂, 1 ♀ (?);
    "Bogotá," 1 (?);
    Medellin, 1 (?);
    La Costa, El Tambo, 1 ♀;
    "Colombia," 2 (?).

Delothraupis castaneoventris peruviana Carriker

Delothraupis castaneiventris [sic] *peruvianus* CARRIKER, 1935 (Oct. 25), Proc. Acad. Nat. Sci. Philadelphia, vol. 87, p. 358—Auquimarca, Perú; ♂; Acad. Nat. Sci. Philadelphia.

Most of the characters ascribed to this subspecies are of no value. There is no difference in the size of the bill in Bolivian and Peruvian specimens, and the intensity of color on the under parts, including the chin and throat, varies in both; in fact, the specimen immediately at hand with the least amount of whitish feathering at the base of the bill is from Bolivia.

However, the blackish malar stripe in the Peruvian birds is distinctly narrower and averages shorter than in the Bolivian examples, and the Bolivian birds have the wing shorter. Southeast-Peruvian birds, according to Carriker's measurements and one specimen from that area now before me, are intermediate in respect to the length of wing, but the bird at hand has the malar stripe like that of the birds from central Perú, indicating that southeastern birds belong to *peruviana* rather than to *castaneoventris*.

According to published measurements and the dimensions of the specimens examined, central-Peruvian birds (without regard to sex) have the wing 80–86 mm. in length; southeast-Peruvian birds, 79–81; Bolivian birds, 75–81.5.

Peruvian records thus are from Culumachay, Sillapata, Auquimarca, Pumamarca, San Gaban, Oconeque, and Santo Domingo.

SPECIMENS EXAMINED

D. c. castaneoventris.—
  BOLIVIA:

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[1] Specimens in Chicago Natural History Museum.

Incachaca, 1 ♂, 1 ♀, 1 (?)[1];
Quebrada Onda, 1 (?).
D. c. peruviana.—
Perú:
Marcapata, 1 (?);
Pariayacu, 1 ♀, 1 ♀[2];
Maraynioc, 1 ♀;
Panao, 3 ♂[3], 2 ♀[3];
mountains near Huánuco, 1 ♂[3].

Anisognathus igniventris ignicrissus (Cabanis)

Poecilothraupis ignicrissa Cabanis, 1873, Jour. für Ornith., vol. 21, p. 317—Maraynioc, Perú; Berlin Mus.

Poecilothraupis lunulata intercedens Berlepsch, 1912, Ber. V Internatl. Ornith. Kongr., Berlin, p. 1044—Leimebamba; ♂; Frankfort Mus.

Birds from the northern part of Perú show a slightly longer average wing-length than those from central Perú (89–96.5 mm. as against 93–98) and also average very slightly deeper red on the lower under parts, but there is too much overlap in both characters to permit the recognition of *intercedens*.

Records are from Huambo, Vitoc, and Tamiapampa.

I have elsewhere (1930, Publ. Field Mus. Nat. Hist., zool. ser., vol. 17, p. 444) given the reasons for supplanting *Poecilothraupis* by the earlier *Anisognathus*.

Anisognathus igniventris igniventris (D'Orbigny and Lafresnaye)

A[glaia] igniventris D'Orbigny and Lafresnaye, 1837, Mag. Zool., vol. 7, cl. 2, "Syn. Av.," p. 32—Apolobamba, Bolivia; Paris Mus.

This form replaces *ignicrissus* in the southeastern part of Perú, including the Urubamba Valley. Peruvian birds are inseparable from Bolivian examples.

Records are from Chachupata [= Ccachupata; Cachupata], San Gaban, and Paucartambo.

Specimens Examined

A. i. igniventris.—
Bolivia:
Pucyuni, 1 ♂;
Cillutinacara, 2 ♂;
Cocopunco, 1 (?);
near Rió Aceramarca, 2 ♂;
Incachaca, ♂[1], 3 ♀[1].
Perú:
Marcapata, 1 ♂;
Limbani, 2 ♂, 1 ♀, 1 (?);
Cedrobamba, Machu Picchu, 1 ♂.
A. i. ignicrissus.—
Perú:
Maraynioc, 4 ♂, 2 ♀;
Panao, 1 ♂[3];
mountains near Huánuco, 5 ♂[3], 5 ♀[3];
Compan [Cumpang], 1 (?);
Levanto, 3 ♂, 1 ♂[3];
mountains east of Balsas, 1 ♀[3];
Leimebamba, 2 ♀;
Chachapoyas, 1 ♀;
La Lejia, 5 ♂;
San Pedro, 2 ♂.
A. i. erythrotus.—
Ecuador: 54.
A. i. lunulatus.—
Colombia: 39.

Anisognathus lacrymosus caerulescens (Taczanowski and Berlepsch)

[*Poecilothraupis palpebrosa*] *caerulescens* Taczanowski and Berlepsch, 1885, Proc. Zool. Soc. London, p. 80, in text—Cutervo, Perú; ♂; type from Berlepsch Collection in Amer. Mus. Nat. Hist.

The allocation of the name *caerulescens* is open to a certain amount of study. The first use of the name is in the reference cited above where it appears in the discussion of three birds from San Rafael, eastern Ecuador, which Taczanowski and Berlepsch found to be intermediate between Bogotá and Antioquia examples of "*palpebrosa*" and examples from Cutervo, northern Perú. Actually, Bogotá and Antioquia birds belong to *olivaceiceps*, but that does not affect the application of the name *caerulescens*. After noting the intermediate character of the San Rafael birds, Taczanowski and Berlepsch give the characters that distinguish them from the Bogotá and Antioquia form and state that they belong to the "subsp. *caerulescens*, Berl. MS." The characters are even more pronounced in the birds from Cutervo and vicinity than in those from San Rafael, as may be supposed by the comment on intermediacy. Since Cutervo is cited in this 1885 account, it, too, must be counted as one of the original localities.

It was not until 1912 (Ber. V Internatl. Ornith. Kongr., Berlin, 1910, p. 1046) that Berlepsch published a formal description of *caerulescens* with citation of the type specimen, but at that time he noted Cutervo as type locality and specified No. 6784 from his collection as the type, which specimen came into possession of the American Museum of Natural History some years ago and is now before me, marked in Berlepsch's handwriting as "typus." Since he acquired this skin in 1880, as noted on the label, it was in his possession at the time of the publication of the paper by Taczanowski and himself in 1885 and was, without question, one of the original series. There is no reason, therefore, to refuse to accept it as the type of *caerulescens*, the type locality of which is, accordingly, Cutervo, Perú.

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[1] Specimens in Carnegie Museum, Pittsburgh.
[2] Specimen in U. S. National Museum, Washington, D. C.
[3] Specimens in Chicago Natural History Museum.

The matter is of some importance since the birds from the area adjacent to San Rafael are closer to true *palpebrosus* than to the north-Peruvian form, although Taczanowski and Berlepsch's material may have shown a trend in the other direction. To attempt to cite San Rafael as type locality of *caerulescens*, 1885, as has been done by Hellmayr (1936, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 9, p. 187) would necessitate providing a new name for the Cutervo form, a procedure for which there is no need.

This north-Peruvian form, *caerulescens*, differs from *palpebrosus* by lighter yellow under parts, lighter and duller upper parts with a tinge of blue (weaker than in *lacrymosus* of central Perú), and a paler and duller tone of blue on the upper wing-coverts than in either of the others, though closer to the color in *lacrymosus*. The yellow post-auricular spot and the smaller subauricular blotch are present in all the specimens examined, although it is weaker in one or two of the skins from La Lejia, east of the Marañón, than in the others. Hellmayr (*loc. cit.*) found the post-auricular spot lacking in a Cutervo specimen he examined, but it is quite pronounced in the type.

There is perfect intergradation between *caerulescens* and *palpebrosus*. A series of birds from southern Ecuador (Taraguacocha, Loja, and Oña) have the under parts only a little deeper in color than that area in the Peruvian birds; the upper parts average less bluish and a little darker, and the upper wing-coverts are usually a little deeper blue. North-Ecuadorian birds from as far south as the Macas region (which is south of San Rafael) have the under parts averaging still deeper yellow, with the extremes overlapping both the south-Ecuadorian and the Colombian series; the upper parts are not quite so dark as in the Colombian birds and show as little bluish tinge as in *palpebrosus;* and the color of the upper wing-coverts is deep blue, also as in *palpebrosus*. They form the pale extreme of *palpebrosus*, and the dividing line between *palpebrosus* and *caerulescens* thus appears to lie south of the Macas region, between that point and Loja, although it is not sharp at any point.

A similar intergradation takes place between *palpebrosus* and *olivaceiceps* in the central Andes of Colombia where *palpebrosus* occurs at Laguneta, on the western slope, with a tendency toward an olive tinge on the forehead and over the eye. At Medellin, a little farther to the northward, *olivaceiceps* is well developed, and a single bird from Río Toché, very near to Laguneta but on the eastern slope of the Central Range, is distinctly closer to *olivaceiceps* than to *palpebrosus*, even as the latter is modified in the Laguneta specimens. A Bogotá skin shows an approach toward *tamae*.

Records of *caerulescens* are from Paucal, Tambillo, and Leymebamba.

Anisognathus lacrymosus lacrymosus (Du Bus)

Tachyphonus lacrymosus Du Bus, 1846, Esq. Ornith., no. 2, pl. 10—Perú (I suggest Maraynioc); Brussels Mus.

The yellow post-auricular spot is quite absent from most of the individuals of this form, but occasionally there is a suggestion of it on one or two feathers.

Records are from Higos, Chilpes, and Cumpang (= Compan).

[Anisognathus lacrymosus palpebrosus (Lafresnaye)

Tanagra palpebrosa Lafresnaye, 1847, Rev. Zool., vol. 10, p. 71—"Pasto in Peruvia," *errore* = Pasto, Colombia; ♂; Acad. Nat. Sci. Philadelphia.

Although ostensibly from Perú, it is conceded that the locality, Pasto, refers to the place of that name in Colombia. The original description agrees with the characters of the subspecies found in that region to which the name has been assigned in recent years. That subspecies does not reach any part of Perú.]

Specimens Examined

A. l. lacrymosus.—
Perú:
Maraynioc, 1 ♂, 2 ♀;
Rumicruz, 6 ♂, 1 ♀.
A. l. caerulescens.—
Perú:
Cutervo, 1 ♂ (type);
Chugur, 4 ♂, 2 ♀;
Taulis, 2 ♂, 1 ♀;
El Tambo, 3 ♂, 3 ♀;
La Lejia, 2 ♂, 3 ♀.
Ecuador:
Loja, 1 ♂, 1 ? ♀;
Taraguacocha, 3 ♂, 3 ♀;
south of Oña, 1 ♀.
A. l. palpebrosus.—
Ecuador:
(Papallacta, Oyacachi, upper Sumaco, above Baeza, Sical, Zuñac, Tambillo, Galgalan, Macas region, and Monji), 14 ♂, 12 ♀, 6 (?).
Colombia:
(Almaguer, coast range west of Popayan, Santa Isabel, Laguneta, and "Bogotá" = *errore;* not a Bogotá-skin), 17 ♂, 14 ♀, 1 (?).
A. l. olivaceiceps.—
Colombia:
(Medellin, Santa Elena, Paramillo, Río Toché, Sabanalarga, and "Bogotá"), 5 ♂, 6 ♀, 2 (?).
A. l. tamae.—
Venezuela:
Páramo Tamá, 2 ♂ (incl. type[1]).
A. l. melanops.—
Venezuela:
(Mérida, Culata, Nevados, Escorial, El Valle, El Loro, and Cicua Nevada), 14 ♂, 2 ♀, 8 (?).
A. l. melanogenys.—
Colombia:
Santa Marta, El Libano, 4 ♂;
San Lorenzo, 5 ♀.

Buthraupis montana cyanonota Berlepsch and Stolzmann

Buthraupis cucullata cyanonota Berlepsch and Stolzmann, 1896, Proc. Zool. Soc. London, p. 342—Maraynioc, Perú; cotypes, ♂ in Warsaw Mus., ♀ in Amer. Mus. Nat. Hist.

Berlepsch and Stolzmann had five specimens from Maraynioc when they described their *cyanonota.* Stolzmann and Domaniewski (1927, Ann. Zool. Mus. Pol. Hist. Nat., vol. 6, p. 184) claim a male in the Warsaw Museum as type but no specimen was singled out for that honor in the original account, and one of the five original examples (from the Rothschild Collection and now before me) is marked "typus" on the original label. It is a female, while the Warsaw "type" is a male. Presumably both specimens are of equal rank as cotypes of the subspecies.

I can find no distinctions between birds from northern Perú and those from the central part of the country.

Records are from Higos and Pangoa.

Buthraupis montana saturata Berlepsch and Stolzmann

Buthraupis cucullata saturata Berlepsch and Stolzmann, 1906, Ornis, vol. 13, p. 80—Idma, Santa Ana, Perú; ♂; Warsaw Mus.

Apparently confined to southeastern Perú and the Urubamba Valley. Records are from Idma [Santa Ana], and Marcapata Valley.

There appears to be some uncertainty regarding the record from Cosñipata. Sclater and Salvin (1873, Proc. Zool. Soc. London, p. 185) give a list of the species represented in the collection made by Whitely in that general region and not included in a former report. The birds secured at a number of different localities are supposedly marked with distinguishing letters, and the remainder are said to have come from Cosñipata, among which is "*Buthraupis cucullata.*" However, on the following page, there is a special discussion of the form in question of which Whitely is said to have taken two examples at "Huasampilla," with no mention of Cosñipata. Whitley must have taken more than the two examples mentioned, since two are listed in the "Catalogue of birds in the British Museum," (vol. 11, p. 148), Berlepsch (1896) noted one in his collection, and one is in the American Museum of Natural History, all collected by

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[1] Specimen in collection of William H. Phelps, Caracas, Venezuela.

Whitely at "Huasampilla." Nevertheless, there is no apparent reason why *saturata* should not occur at Cosñipata, although the record has yet to be made.

SPECIMENS EXAMINED

B. m. montana.—
BOLIVIA:
Cocapata, 1 ♂, 1 ♀;
San Cristóbal, 1 ♂;
Tanampaya, 1 ♂;
Chaco, Yungas, 1 ♂.
B. m. saturata.—
PERÚ:
Limbani, 1 ♂;
below Limbani, 1 ♂;
Huaisampillo, 1 (?);
Torontoy, 1 ♂.
B. m. cyanonota.—
PERÚ:
Maraynioc (Tambo de Aza), 1 ♀ (cotype);
Maraynioc, 1 ♂, 4 ♀;
Rumicruz, 2 ♀;
Compan, 1 (?);
Leimebamba, 1 ♀, 1 (?);
La Lejia, 2 ♂, 2 ♀.
B. m. cucullata.—
ECUADOR: 34.
COLOMBIA:
(Almaguer, Cocal, Cerro Munchique, Laguneta, and Santa Isabel), 5 ♂, 6 ♀.
B. m. gigas.—
COLOMBIA:
Subia, 1 ♂, 1 ♀;
El Piñón, 3 ♀;
Anolaima, 2 ♂;
"Bogotá," 12 (?).

Compsocoma flavinucha somptuosa (Lesson)

Tachyphonus somptuosus LESSON, 1831, Traité d'ornithologie, p. 463—no locality; the type in the Paris Museum said to have been collected in Perú.

Examples of this species from northern Perú and southeastern Ecuador are recognizably distinct from those found in central Perú. Not only is the yellow color of the under parts and the crown somewhat deeper in tone, as pointed out by Chapman (1926, Bull. Amer. Mus. Nat. Hist., vol. 55, p. 670), but the outer margins of the rectrices are brighter and less greenish blue, the outer margins of the remiges also less greenish although not so distinctly brighter. A bird from Cueva Seca, on the Río Mixiollo, Huallaga Valley, is clearly like the northern examples, while three skins from Cushi Libertad are more like the Junín specimens although with a trend toward the characters of the northern birds.

It is justifiable, therefore, to separate the two populations under distinctive names, but this cannot be done until it is determined to which form the type of *somptuosa* belongs. Hellmayr (1936, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 9, p. 203) notes that the type was collected by Ajassou, but I am quite unfamiliar with this name and have no information as to the portion of Perú in which he may have traveled. The naming of the new form must, therefore, await the determination of the application of the name *somptuosa.*

Records which belong to the northern population are from Charapi, Chirimoto, Ray-urmana, and Piquitambo. Records that are assignable to the Junín form are from Paltaypampa, Garita del Sol, Auquimarca, "Marca" (probably Auquimarca), Chanchamayo, and "Eastern Perú" (Tschudi).

Compsocoma flavinucha flavinucha (D'Orbigny and Lafresnaye)

T[achyphonus] flavinucha D'ORBIGNY AND LAFRESNAYE, 1837, Mag., Zool., vol. 7, cl. 2, "Syn. Av.," p. 29—Yungas (Bolivia); Paris Mus.

Although not recorded heretofore, this form occurs in southeastern Perú in the vicinity of Santo Domingo. I can find no distinctions between Peruvian and Bolivian birds.

SPECIMENS EXAMINED

C. f somptuosa.—
PERÚ:
Chaupe, 2 ♂, 3 ♀;
Uchco, 1 ♂;
Chachapoyas, 1 ♂, 2 ♀;
Cueva Seca, 1 [♀];
Chilpes, 5 ♂, 3 ♀;
Cushi Libertad, 2 ♀, 1 ♀.
ECUADOR:
Zamora, 2♂, 1♀;
Sabanilla, 1 ♂, 2 ♀;
Cutucú, 1 ♀.
C. f. flavinucha.—
PERÚ:
Santo Domingo, 9 ♂, 7 ♀;
Inca Mine, 2 ♂.
BOLIVIA:
Incachaca, 8 ♂, 2 ?♂, 4 ♀;

Locotal, 1 ♂, 2 ♀;
Roquefalda, 1 ♂, 1 ♀;
Quebrada Onda, 1 ♂;
San Cristóbal, 1 ♂.

C. f. alamoris.—
ECUADOR:
(Alamor, Salvias, El Chiral, San Bartolo, and Celica), 17 ♂ (incl. type), 7 ♀.

C. f. baezae.—
ECUADOR:
Baeza, 6 ♂ (incl. type), 3 ♀;
below Baeza, 1 ♀;
(a series of specimens collected by Goodfellow and Hamilton and labeled "w. Pichincha," "Mindo," "above Milligalli," and "Canzacota"—*errore*), 5 ♂, 3 ♀.

C. f. cyanoptera.—
ECUADOR:
"Papallacta" (*errore*, by Goodfellow and Hamilton), 6 ♂, 3 ♀;
(Pallatanga, Gualea, "Quito," Zaruma, Porvenir, and "Equador"), 2 ♂, 5 ♀, 2 (?).
COLOMBIA:
[San Antonio, Cerro Munchique, La Florida, La Sierra, Salento, east of Palmira, Gallera, Cocal, Cauca Valley, El Roble (near Salento, not E. Andes), "New Grenada" and "Bogotá" (*errore;* not a "Bogotá trade skin)], 19 ♂, 15 ♀, 7 (?).

C. f. victorini.—
COLOMBIA:
(Subia, El Roble, La Candela, near San Augustin, Anolaima, La Palma, and "Bogotá"), 15 ♂, 5 ♀, 8 (?).

C. f. antioquiae.—
COLOMBIA:
(Barro Blanco, Santa Elena, Paramillo Trail, Las Cruces, Retiro, La Ceja, El Eden, Medellin, and Río Toché), 8 ♂, 4 ♀, 6 (?).

C. f. venezuelana.—
VENEZUELA:
[Galipan, Cumbre de Valencia, near Bucarito (Tocuyo), Colonia Tovar, between El Limón and Colonia Tovar, "Caripé" (*ex* Mocquerys; presumably not the Caripé in Bermúdez)], 5 ♂, 5 ♀, 6 (?).

Dubusia taeniata stictocephala Berlepsch and Stolzmann

Dubusia stictocephala BERLEPSCH AND STOLZMANN, 1894, Ibis, vol. 6, pt. 6, p. 386—Maraynioc, Perú; cotypes in Warsaw Mus., Amer. Mus. Nat. Hist., and possibly Frankfort Mus.

There is a wide hiatus between the known ranges of this form and typical *taeniata*, embracing the whole of northern Perú south to the Junín region. Nevertheless, I consider the differences to be only of subspecific value. Specimens of *taeniata* from eastern Ecuador frequently show a definite trend toward the characters of *stictocephala* by having the feathers of the mantle distinctly tipped with silvery blue and those of the hind neck sometimes even more brightly marked. It is possible that closer intergrades may yet be found in suitable terrain in northern Perú. The range of *taeniata* approaches the Peruvian border but is not known to cross it.

Among the material at hand is one of Berlepsch and Stolzmann's original specimens clearly marked "typus." Since a "type" is claimed for the Warsaw Museum and other specimens, possibly cotypes, are said to be in the Berlepsch Collection, now in the Frankfort Museum, I must consider the bird at hand and the Warsaw specimen as cotypes—possibly also the Frankfort examples.

Records of *D. t. stictocephala* are from Huarmipaycha and Occobamba Valley.

Hellmayr (1936, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 9, p. 197) proposes the acceptance of *Dubusia selysia* = *Tanagra selysia* as type of the genus *Dubusia* by "virtual orig. desig." as being the sole species in the original account whose specific name was there listed in combination with the new generic name. I doubt the validity of this claim. In the first place, the name *taeniata* is listed also in combination with *Dubusia,* and even if *taeniata* and *selysia* are synonymous, as appears to be the case, Bonaparte did not consider them as such and did not specify either as the type. In any case, seven other species are assigned by Bonaparte to *Dubusia*, albeit without formally combining the specific and the new generic names, and any one of them is available as type. To avoid any possibility of confusion or undue change in accepted nomenclature, I hereby designate *Dubusia selysia* (Bonaparte) = *Tanagra selysia* Bonaparte as type of the genus *Dubusia* Bonaparte, 1850.

SPECIMENS EXAMINED

D. t. taeniata.—
VENEZUELA:
Escorial, Mérida, 1 ♂;
San Antonio, Mérida, 1 ♂.
COLOMBIA:
("Bogotá," El Piñón, Subia, and west of Popayán), 2 ♂, 2 ♀, 1 (?).

Ecuador:
(Pichincha, Yanacocha, "Quito," Chivinda, Taraguacocha, Zuñac, Riobamba, Baeza, Oyacachi, Sumaco, Macas region, and "Napo ?"), 9 ♂, 6 ♀, 7 (?).

D. t. stictocephala.—
Perú:
Maraynioc, Pariayacu, 1 ♂ (cotype);
Rumicruz, 1 ♂, 2 ♀.

Thraupis episcopus quaesita Bangs and Noble

Thraupis cana quaesita Bangs and Noble, 1918, Auk, vol. 35, p. 460—Sullana, Perú; ♀; Mus. Comp. Zoöl.

This subspecies is confined to the region west of the Andes in extreme northwestern Perú, western Ecuador, and southwestern Colombia. Whereas there is in *caerulea* some indication of a trend toward this form, I can find no suggestion of a similar, opposite trend in *quaesita*, even in birds from Palambla, just across the divide from Huancabamba.

Records are from Sullana, Paletillas, Mórrope, Paucal, Piura, La Laja, Romeros, and Lechugal.

Thraupis episcopus mediana, new subspecies

Type: From Manaos, Brazil. No. 233638, American Museum of Natural History. Adult male collected August 20, 1927, by G. H. H. Tate and T. D. Carter; original no. 38.

Diagnosis: Similar to *T. e. episcopus* of French Guiana, but males with the top of the head a little deeper blue and wing with more white on the greater upper coverts—usually with a decided bar formed by the white tips of these feathers.

Range: Southwestern Venezuela, on the Cassiquiare; northern Brazil on the Rio Negro and Rio Uaupés (and the Colombian side of the Uaupés); east to the Rio Jamundá and (on the south bank of the Amazon) to the Tapajoz; west to the Rio Madeira (both banks), ascending that stream to Porto Velho and possibly farther.

Description of Type: Top of the head Lumiere Blue × Etain Blue (Pale Neropalin Blue);[1] mantle Glaucous-Blue (Cadet Gray); rump Sky Gray (pale Burn Blue); upper tail-coverts a little darker. Throat Pale Glaucous-Blue (Sky Gray); breast and sides Persian Blue (Burn Blue); flanks like the sides; belly a little paler; under tail-coverts duller. Primaries and secondaries with outer margins Olympic Blue (Vanderpoel's Blue); tertials duller—a little greenish—with indistinctly defined whitish areas at the tips of the outer webs; greater upper wing-coverts broadly tipped with white extending basad along the outer margins of the feathers—rather broadly on the outer ones; lesser and median coverts white; under wing-coverts whitish washed with pale blue; inner margins of remiges pale. Tail with exposed outer margins the color of the primary margins. Bill (in dried skin) blackish; feet dusky brown. Wing, 87.5 mm.; tail, 62; exposed culmen, 13; culmen from base, 17; tarsus, 20.

Remarks: Females sometimes indistinguishable from the males but averaging paler and duller and with less white on the greater upper wing-coverts; shoulder usually clearer white, less lilac tinged.

This form is admittedly intermediate between *episcopus* and *coelestis*, but it is relatively consistent over a very extensive range and deserves recognition as a distinct form.

While *T. e. episcopus* often has the shoulder apparently clear white, especially when comparison is made with the lilac-shouldered *nesophila*, there is usually a trace of lilaceous coloration, sometimes quite obvious, against which the shoulder of *mediana* appears still whiter. The pale tips and edges of the greater upper wing-coverts also are definitely lilac-blue in all Guianan birds and never form a decided wing-bar, whereas in *mediana* they are whiter and often very broad and conspicuous.

There is more tendency toward intergradation between *mediana* and *episcopus* than between *mediana* and *coelestis* where the distinction is more abrupt. Specimens from the Xingú, Tapajoz, Pará district, and northern Goyaz are very close to the Guianan specimens, although they show a little stronger tinge of lilac on the shoulder in some examples. In any case, none of these birds has a well-marked wing-bar and but little whitish edging is on the greater wing-coverts. My material from the Tapajoz and Villa Bella Imperatríz, just west of that stream, is limited, but has more pronounced white on the greater coverts as do specimens from Faro, on the north bank of the Amazon. When the series are laid out from the different areas, these Faro-Tapajoz-Villa Bella Imperatríz birds agree a little better with *mediana* than with *episcopus*.

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[1] Colors in parentheses are with the bird held toward the light.

Likewise, an occasional specimen from the course of the Rio Negro and its upper affluents shows a diminution of white on the wing-coverts suggesting a trend toward *episcopus*, but other examples from the identical localities frequently show a decided, white wing-bar, preventing association with the Guianan form. One bird from San Gabriel has the blue areas rather greener and shows a decided likeness to *leucoptera* of eastern Colombia. It is the only specimen so marked.

Two birds from Mt. Duida are rather difficult to place. Neither has much white on the greater wing-coverts, although both are sexed as males. They can be matched more closely with certain extreme examples of *mediana* than with *episcopus*, especially in respect to the darker hue of the head, and probably belong to *mediana* as, indeed, the geographic position would suggest.

A bird labeled "Yungas, Bolivia," collected by Rusby, belongs to this form but may have been collected outside of the boundaries of Bolivia, perhaps on the Rio Madeira. There is no other record from Bolivia.

Association of the Duida birds with *episcopus episcopus* is difficult for geographic reasons. I find myself unable to agree with Hellmayr (1936, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 9, p. 213, footnote 1) that birds from the Orinoco Valley are pronouncedly intermediate between *cana* and *nesophila*, but find them decidedly close to *nesophila* with very little variation in the direction of *cana*. On the other hand, an occasional *cana* shows a little more violaceous coloration on the shoulder than the great majority of specimens of that form, and between Caracas and the Paria Peninsula there is evident intergradation, making the identification of birds from that area rather puzzling; but Orinoco birds I believe to be unequivocally referable to *nesophila*, at least as far upstream as Maipures and Ayacucho.

In this same category are specimens from Roraima and Auyan-tepui in Venezuela, and from Frechal, Rio Surumú, Brazil—all with strongly violaceous shoulders. There is a tendency toward *episcopus* in this region, evidenced by somewhat paler violaceous shoulders than in Orinoco birds. On the other hand, specimens of *episcopus* from British Guiana show a trend toward *nesophila* by having more evident violet tints on the shoulder, but here the closest affinity is with the Cayenne population.

In any case, the presence of *nesophila* in an intermediate area seems to close any avenue of connection between the Guianas and Duida.

Thraupis episcopus caerulea Zimmer

Thraupis episcopus caeruleus Zimmer, 1929, Proc. Biol. Soc. Washington, vol. 42, p. 94—Vista Alegre, Perú; ♂; Chicago Natural History Museum.

I have found the delimitation of this form extremely difficult since there is perfect intergradation between it and *coelestis* of the upper Amazonian region of western Brazil. There is no point at which sharp demarcation takes place.

Beginning at Caviana, west of the Rio Madeira, there is an increase in the intensity of coloration on the top of the head, which reaches its strongest development in the neighborhood of Moyobamba. A Caviana male has the top of the head Light Neropalin Blue (with the bird held toward the light). At Teffé, the color approaches Neropalin Blue. At Tonantins, the darkest bird has the cap Neropalin Blue × Alice Blue. Males from northeastern Perú and one specimen from Loretoyacu, Colombia, reach a greater extreme, sometimes approaching Pale Cadet Blue, but in general the hue remains in the clear "Blue" column, not verging on the greenish tones.

These birds from Caviana westward also have the mantle relatively clear and light in hue and with a bluish tinge when held toward the light. The tips of the feathers are a little paler than the subterminal areas and, when the plumage is abraded, often appear conspicuously light.

At the most strongly colored end of the scale are, as noted, some of the Moyobamba males which have the top of the head approaching Vanderpoel's Blue. Other males from the same region are less intensely colored, with the cap near King's Blue, and still others are intermediate. These birds appear to be adult, since examples that are obviously immature have the cap still duller and the shoulder and wing-bar very dull or obsoletely marked—not the clear white of adults. In the upper Huallaga region there is less intensity of blue on the head, and in the middle Marañón region and other adjacent areas the color is even more greenish, approaching Squill Blue. All these birds, however, have the mantle darker, more clouded, and more greenish in tone than in the birds of the lower, more eastern region, and the outer surface of the wing and tail also averages more greenish blue. In spite of the range of variation, therefore, all these Andean birds may be included in *caerulea* in default of a number of additional groups of minor importance in which each degree of difference would have to be segregated.

Some difficulty occurs in trying to assign the specimens from the lower Huallaga and the Ucayali rivers. They show various stages of intermediacy but are not certainly assignable to one form or the other. In general the Ucayali birds show a closer approximation to *coelestis*, having the mantle relatively light in color and the cap rather clear blue. The lower Huallaga birds have the mantle rather clearer than that of typical *caerulea*, but the head is a little more greenish blue than in *coelestis*. I prefer to keep them in *caerulea*.

Females of *coelestis* are distinguishable from females of *caerulea* by their lighter color of head and back, although in both forms the coloration of the head is less strongly developed than in the respective males.

Two specimens from Huancabamba and Pucará, respectively, have the wing-bar greatly reduced and the shoulder-patch noticeably lilaceous instead of white. Both appear to be adult males. Since the range of *quaesita*, with its blue shoulder and no wing-bar, occurs just over the divide on the western side of the Western Andes, perhaps the peculiarity of the two skins in question is an indication of a degree of intermediacy.

Peruvian records of *caerulea*, as limited here, are from Callacate, Viña, Jeberos, Chamicuros, Guajango, and Huambo.

Thraupis episcopus coelestis (Spix)

Tanagra coelestis Spix, 1826, Av. Spec. Nov. Brasil., vol. 2, p. 42, pl. 55, fig. 2—(part) descr. male; Fontebôa and Pará, Brazil; ♂; restricted to Fontebôa by Hellmayr, 1906; Munich Mus.

Tanagra ehrenreichi Reichenow, 1915, Ornith. Monatsber., vol. 23, p. 154—Hyutanahán, Rio Purús, Brazil; 2 ♂, 1 ♀; Berlin Mus.

This subspecies, as noted in the discussion of *caerulea*, is variable, showing the strongest coloration in the more western part of the range and the lightest toward the east. I have not seen material exactly topotypical of *coelestis*, but specimens from Teffé and from São Paulo de Olivença are not distinguishable from each other, and Fontebôa lies between these two localities.

Several specimens from the Rio Purús, kindly lent by Mr. Todd, show the agreement of the supposedly distinct "*ehrenreichi*" with *coelestis* and not with the form from the Rio Madeira separated hereunder.

Peruvian records that may be assigned to *coelestis* are from Pebas, Cumaria, and "Lower Ucayali."

Thraupis episcopus major (Berlepsch and Stolzmann)

Tanagra coelestis major Berlepsch and Stolzmann, 1896, Proc. Zool. Soc. London, p. 343—La Merced, Chanchamayo, and Garita del Sol, Perú; cotypes in Warsaw Mus., Amer. Mus. Nat. Hist., and Frankfort Mus.

The name *major* is not highly appropriate for this form since most examples of it are no larger than individuals of some other forms. The form is, however, quite distinct, although relatively limited in distribution, being confined to the Chanchamayo Valley region of central Perú. Its colors are lighter in tone than those of the other Peruvian forms except a new subspecies from southeastern Perú described hereunder.

Berlepsch and Stolzmann did not publish any facts indicating the selection of a definite type specimen of this form, although Stolzmann and Domaniewski (1927, Ann. Zool. Mus. Pol. Hist. Nat., vol. 6, p. 185) claimed this honor for a male in the Warsaw Museum. There are, however, other specimens apparently entitled to share the honor of the rank of cotypes. Among these are two of the original series collected by Kalinowski—a male from Garita del Sol and a female from La Merced, both marked "typus" on the original labels. A third male from La Merced, with similar origin, is not marked in this way, indicating some selection in the matter, even though nothing was published concerning it in the original account. The type locality may remain as La Merced.

Records that should be assignable to *major* are from San Juan.

Thraupis episcopus urubambae, new subspecies

TYPE: From Santa Ana, Urubamba Valley, Perú; altitude 3500 feet. No. 145784, American Museum of Natural History. Adult male collected July 15, 1916, by Frank M. Chapman and George K. Cherrie.

DIAGNOSIS: Similar to *T. e. major* of central Perú, but top of the head paler and duller. Wing-bar averaging a little less clearly white.

RANGE: Urubamba Valley and extreme southeastern Perú in the Amazonian drainage.

DESCRIPTION OF TYPE: Top of the head Dark Glaucous-Gray (Light Medici Blue); mantle Grayish Blue-Green × Deep Grayish Blue-Green (Medici Blue × Deep Medici Blue); rump Pale Dull Glaucous-Blue × Light Niagara Green (Pale Russian Blue); upper tail-coverts about like the mantle. Throat and breast Pale Glaucous-Blue (Russian Blue × Pale Russian Blue); flanks slightly darker; belly and under tail-coverts paler. Outer margins of outer remiges Motmot Blue × Methyl Green (Chessylite Blue), becoming darker and a little greener on the inner feathers. Shoulder white; greater wing-coverts tipped with slightly dull whitish; under wing-coverts white; inner margins of remiges dull whitish. Tail with exposed edges like the outer margins of the primaries. Bill (in dried skin) blackish; feet dark brown. Wing, 99 mm.; tail, 66.5; exposed culmen, 11.5; culmen from base, 16; tarsus, 19.8.

REMARKS: Female like the male but averaging duller and paler and usually with the wing-bar reduced or inconspicuous.

This form appears to be relatively constant in characters and shows no distinctions between the Urubamba Valley and southeastern Perú.

Peruvian records are from Marcapata, Pintobamba, Occobamba, Huaynapata, Chaquimayo, San Gaban, and Astillero.

Through the kindness of Mr. Rodolphe de Schauensee of the Academy of Natural Sciences of Philadelphia, I have been able to examine the type and other specimens of *T. e. boliviana* whose relationship to *urubambae* might have been questioned.

This is a puzzling form whose status cannot be determined with complete satisfaction until more adequate series of birds are available from western Bolivia. *T. e. boliviana* would make a good connectant between the *episcopus* and *sayaca* groups. The color of wings and tail is that of *sayaca*, the wing-bar is nearly obsolete though lightly suggested, and the shoulder is neither white nor the deep blue of *sayaca* but an intermediate hue that is different in all four known specimens of *boliviana*. In the type, from Chatarona, the shoulder is Light Neropalin Blue (held toward light); in the female from Chatarona it is a duller tone of the same hue; in the male from Huanay, it is much more whitish, with a tinge of blue; and in the other bird from Huanay (with sex questioned but with the notation "T.M.E.") the shoulder is more strongly blue than in the Huanay male but less than in the Chatarona female.

The top of the head and the back are paler than in *urubambae* but with a slight bluish tinge, and are much paler than in *sayaca obscura*.

T. sayaca obscura is at hand from Apolo and is recorded from Sandillani. Both these localities are at higher elevations than Huanay and Chatarona, so it is not impossible that there is a zonal separation of ranges of the two groups in northwestern Bolivia. Nevertheless, *T. episcopus urubambae* is found at Santo Domingo, Perú, at an elevation as high as that of Apolo, and *obscura* occurs at Todos Santos, lower than Huanay.

Four specimens collected by Rusby in Bolivia are at hand. Two examples of *obscura* are labeled as from the [Province of] Yungas, 6000 feet, presumably quite correctly; a third example of the same form is labeled as from the lower Beni, while a specimen of *T. e. mediana*, probably from the lower Beni, is labeled as from the Yungas at 6000 feet. I suspect that the labels of these last two birds should be transposed. That would place the specimens of *obscura* as coming from somewhere near Sandillani and the example of *mediana* as taken on the lower Beni where it may be suspected to occur.

Thus, there is a possibility that *boliviana* represents an intermediacy between *T. s. obscura* and *T. e. mediana*, but until more is known of the variability of the population in the upper Beni region, it would be unwise to propose specific union of the two groups, both of which occur there, although apparently not at the same localities. Union of the two groups would necessitate the use of the specific name, *sayaca*, for the combined group.

Specimens Examined

T. e. episcopus.—
French Guiana:
(Cayenne and Approuague), 4 ♂, 4 ♀, 1 (?).
Dutch Guiana:
(Paramaribo, Kwata, and "Surinam"), 13 ♂, 1 ♀, 1 (?).
British Guiana:
(Rockstone, Minnehaha Creek, Wismar, Potaro Landing, Tumatumari, Quonga, Annai, and "Demerara"), 7 ♂, 3 ♀, 10 (?).
Brazil:
(Utinga, Pará, Igarapé Assú, Maguary, and Camotins), 5 ♂, 2 ♀;
Ilha São Luiz, 2 ♂, 4 ♀, 1 (?);
Maranhão (Estiva, Ilha Jeanna, and Ilha Bom Fin), 1 ♂, 2 ♀;
Piauhy, Therezina, 3 ♂;
Rio Tocantins (Baião and Mocajuba), 6 ♂, 1 ♀;
Rio Xingú (Tapará and Porto de Moz), 7 ♂, 1 ♀;
Rio Majarý, Recreio, 1 ♂.

T. e. mediana.—
Brazil:
Rio Negro, Manaos, 14 ♂ (incl. type), 11 ♀;
(Muirapinimá, Igarapé Cacao Pereira, Tauapessasu, Tahuapunto, Iauarete. Tatú, San Gabriel, Santa Maria, Tabocal, Yavanari, and Yucabí), 36 ♂, 24 ♀, 1 (?);
Faro, 6 ♂, 11 ♀;
Rio Tapajoz (Tauarý, Aramanaý, Igarapé Brabo, and Santarem), 2 ♂, 6 ♀, 1 (?);
Villa Bella Imperatríz (Lago Andirá, Boca R. Andirá, and Santa Clara), 9 ♂;
Rio Madeira (Borba, Igarapé Auará, Rosarinho, Santo Antonio de Guajará, Porto Velho, and Calamá), 27 ♂, 12 ♀;
Rio Solimoës, 1 ♂;
? "Bolivia, Yungas," 1 (?).
Colombia:
Río Uaupés, opposite Tahuapunto [Brazil], 1 ♂.
Venezuela:
Río Cassiquiare, El Merey, 2 ♂, 1 ♀;
? Mt. Duida (Esmeralda and Playa del Río Base), 2 ♂.

T. e. berlepschi.—
Tobago: 12 ♂, 10 ♀, 2 (?).

T. e. nesophila.—
Trinidad:
(Caparo, Seelet, Chaguaramas, Carenage, Pointe Gourde, Valencia, Savannah Grande, Princestown, Heights of Aripo, and "Trinidad"), 27 ♂, 10 ♀, 3 (?).
Monos Island: 1 ♀.
Venezuela:
(Guanoco, Cristóbal Colón, Cocollar, La Latal, Río Neveri, Carapás, Cuchivano, Ayacucho, Caicara, Las Barrancas, Maripa, Quiribana de Caicara, La Unión, Altagracia, Ciudad Bolívar, Agua Salada de Ciudad Bolívar, Sacupana, Maipures, Roraima, and Auyan-tepui), 35 ♂, 23 ♀, 2 (?).
Brazil:
Frechal, Rio Surumú, 1 ♂, 1 ♀.

T. e. cana.—
Venezuela:
(Caracas, Cotiza, Colonia Továr, El Limón, Las Trincheras, above La Guaira, Tucacas, Cumanacoa, San Antonio, San Estéban, Salsipuede, Quebrada Seca, Valle Santa Ana, Campos Alegre Valley, and Mérida), 22 ♂, 14 ♀, 10 (?).

Colombia:
(Cartagena, Las Lomitas, Florida, Noanamá, Juntas de Tamaná, Puerto Valdivia, Antioquia, Navarro, Río Frío, Caldas, near Honda, Popayan, La Frijolera, Dabeiba, Tumaco, San José, San Antonio—Cauca, San Antonio—Cundinamarca, El Carmen, Nóvita, Chicoral, Tenasuca, Alto de La Paz, near San Augustín, Anolaima, Andalucia, Cauca River, east of Palmira, La Mar, Santa Marta, Donama, Cacagualito, Bonda, and "Bogotá"), 42 ♂, 31 ♀, 24 (?).
Panamá:
(Cape Garachiné, Tapalisa, El Real, Río Chucunaque, and Ensenada Guayabo Chiquito), 4 ♂, 5 ♀.

T. e. diaconus.—
Panamá:
(Saboga I., San Miguel I., Sevilla I., Leones I., Espartal I., Afuera I., Jicaron I., Coiba I., El Rey I., Pacheco I., San José I., Pedro Gonzales I., Vivienda I., La Chorrera, "Panamá" = Lion Hill, Savanna near Panamá, Gatún, Almirante, Cocoplum, Santa Fé, Santiago, Chitrá, Bogava, Boquete, Tocumé, Monte Oscuro, Veragua, and Boqueron), 42 ♂, 29 ♀, 6 (?).
Costa Rica: 14 ♂, 10 ♀.
Nicaragua: 4 ♂, 4 ♀.
Guatemala: 11 ♂, 11 ♀, 2 (?).
Honduras: 3 ♂, 1 (?).
Mexico: 5 ♂, 4 ♀, 4 (?).

T. e. leucoptera.—
Colombia:
(Barrigon, Buena Vista, and Quitame), 1 ♂, 6 ♀.

T. e. quaesita.—
Colombia:
Barbacoas, 1 ♂, 1 (?).
Ecuador:
(Esmeraldas, Santa Rosa, Chone, Daule, coast of Manaví, Río de Oro, Loja, Las Piñas, Naranjo, Bucay, Isla Puna, Zaruma, Casanga, Alamor, Portovelo, Río Jubones, Gualea, Duran, Salvias, Guainche, Cebollal, Cachabí, Chimbo, Santo Domingo, Guancillo, and Guayaquil), 43 ♂, 33 ♀, 2 (?).
Perú:
Túmbes, 1 ♀;
Sullana, 5 ♂, 4 ♀;
Paletillas, 2 ♂, 2 ♀;
Pilares, 1 ♂, 1 ♀;
Palambla, 3 ♂, 3 ♀.

T. e. caerulea.—
Ecuador:
Zamora, 2 ♀;
Sabanilla, 2 ♀.
Perú:
Sauces, 1 ♂, 1 ♀;
Jaen, 1 ♂, 2 ♀;
Lomo Santo, 1 ♂;
Pucará, 1 ♂;
San Felipe, 1 ♂, 1 ♀;
Huancabamba, 3 ♂;
San Ignacio, 1 ♂, 2 ♀;
Cabico, 1 ♂;
Perico, 3 ♀;
Huarandosa, 1 ♂;
Charapi, 1 ♂;
Tamborapa, 2 ♂[1];
Saposoa, 1 ♂[1];
Uchco, 1 ♂;
Río Seco, 3 ♂, 1 ♀;
Chachapoyas, 1 ♀;
Yurimaguas, 2 ♂[2];
Tarapoto, 1 (?);
Moyobamba, 5 ♂[2], 7 ♀[2];
Vista Alegre, 2 ♂[2] (incl. type), 1 ♀[2];
Chinchao, 3 ♂[2], 1 ♀[2];
[Santa Rosa de] Huayabamba, 1 ♂, 2 ♀;
Nuevo Loreto, 1 (?).

T. e. major.—
Perú:
Tulumayo, 5 ♂;
Perené, 3 ♂, 1 ♀;
Utcuyacu, 1 ♂;
Vitoc, 1 ♂ (cotype);
La Merced, 1 ♂, 4 ♀ (incl. cotype);
Chanchamayo, 1 ♀;
San Ramón, 2 (?).

T. e. urubambae.—
Perú:
Santa Ana, 1 ♂ (type), 1 ♀;
Idma, 4 ♂, 1 ♀;
Chauillay, 1 ♂;
Astillero, 2 ♀;
Potrero, 1 ♀;
Cosñipata, 1 ♂, 1 ♀;
Huiro, 2 ♀[1].

T. e. boliviana.—
Bolivia:
Chatarona, 1 ♂ (type)[1], 1 ♀[1];
Huanay, 1 ♂[1], 1 (?)[1].

T. e. coelestis.—
Perú:
Pozuzo, 1 ♂;
"Upper Ucayali," 1 (?);
Santa Rosa, 2 ♂, 6 ♀;
Lagarto, 1 ♂;
Sarayacu, 3 ♂, 2 ♀;
Orosa, 1 ♂;
Apayacu, 2 ♂, 5 ♀;
Puerto Indiana, 1 ♂, 2 ♀;
mouth of Río Curaray, 1 ♀, 1 ♀[1];
Iquitos, 1 (?);
Nauta, 1 ♂.
Ecuador:
"Napo," 2 (?);
mouth of Lagarto Cocha, 1 ♀;
Archidona, 2 ♂, 1 ♀;
valley of Gualaquiza, 1 (?);
Macas region, 3 ♂, 2 ♀;
"Santa Rosa (Dalmas), 1 (?);
"El Loreto," 1 (?).

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[1] Specimens in Academy of Natural Sciences, Philadelphia.

[2] Specimens in Chicago Natural History Museum.

- COLOMBIA:
  - La Morelia, 3 ♂, 1 ♀, 1 (?), 1 ♂[1], 1 ♀[1];
  - Loretoyacu, 1 ♂.
- BRAZIL:
  - Teffé, 10 ♂, 9 ♀;
  - Caviana, 1 ♂[2].
  - Tonantins, 2 ♂[2];
  - Arimã, 2 ♂[2];
  - Hyutanahán, 1 [♂][2].

Thraupis palmarum melanoptera (Sclater)

Tanagra melanoptera SCLATER, "1856" [= Jan., 1857], Proc. Zool. Soc. London, vol. 24, p. 235—E. Peru; British Mus.

Thraupis palmarum duvida CHERRIE, 1916 (May), Bull. Amer. Mus. Nat. Hist., vol. 35, p. 190—Carapanha, Rio Roosevelt, Brazil; ♂; Amer. Mus. Nat. Hist.

This appears to be a very wide-ranging subspecies from the eastern side of the Andes in Colombia, Ecuador, and Perú to Trinidad, the three Guianas, and the Pará district of Brazil, extending thence southwestward across northern Matto Grosso to northern Bolivia.

In this wide area there is a gradually increasing trend toward typical *palmarum* as the more eastern parts of the range are approached. The greenish edges of the remiges become a little broader (or more frequently so), the top of the head may average a little duller, the mantle tends to become slightly lighter in tone, and the under parts likewise have an average tone somewhat lighter than in Peruvian specimens. The strongest expression of these trends is found in the Pará district and on the Rio Xingú. On the Tocantins, at Faro, and in French Guiana they appear to be less evident. On the Madeira and the Negro, in British and Dutch Guiana, and in Venezuela there is less departure from topotypical examples. At almost any place east of Colombia, Perú, and Ecuador, there is slight differentiation from the birds of these three countries, but it is impossible to draw a satisfactory line until the range of *palmarum* is reached in eastern Brazil, from Maranhão to São Paulo and southern Matto Grosso. I have seen no material from Santa Catharina or from Paraguay.

Two specimens from the Province of Sara in eastern Bolivia are not clearly distinguishable from parts of this intergrading population, but without more material it is unsafe to attempt their assignment to one form or the other.

In addition to the localities in Perú from which material has been examined, there are records from Iquitos, Rioja, Monterico, La Merced, Lamas, San Miguel Bridge, Río Cadena, and Caradoc.

Although *T. p. melanoptera* is the only subspecies of *palmarum* found in Perú, it will be advisable to fix a definite type locality for it, and I suggest San Ramón, Chanchamayo Valley, as a satisfactory, central locality known to have been visited by collectors prior to the date of the description of this form.

Although *T. p. violilavata* of western Ecuador is found so near to the boundary of Perú that its occurrence on the Peruvian side is almost certain, I have no positive evidence of such occurrence. This dark form may, therefore, be left in abeyance for further consideration as a Peruvian form when satisfactory evidence is forthcoming.

SPECIMENS EXAMINED

- *T. p. palmarum.*—
  - BRAZIL:
    - Maranhão (Kelsú, Ilha São Luiz, S. João dos Patos, Flores, Ilha Itauna, As Mangueras, and Riachão), 19;
    - Goyaz (Fazenda Esperança), 1;
    - Ceará (Viçosa), 4;
    - Bahia (Jaguaquará, Iracema, Santa Ritta, Cajazeiras, Bahia), 12;
    - "Brasilia" [= Canaveiras, Bahia], 1 ♂ (type);
    - Minas Geraës (Rio Jordão), 1;
    - São Paulo (S. Sebastião), 2;
    - Piauhy (Patos, Bello Horizonte, Therezina, Corrente, and Gilbues), 9;
    - Espirito Santo (Lagôa Juparaná), 4;
    - Rio de Janeiro, 1;
    - Matto Grosso (Chapada, Abrilongo, and Santa Ritta do Araguaya), 44.
  - BOLIVIA:
    - Prov. Sara, 2 (subsp. incert.).
- *T. p. melanoptera.*—
  - PERÚ:
    - Astillero, 3 ♂;
    - Río Tavara, 1 ♂, 1 ♀;
    - Cosñipata, 1 ♂, 1 ♀;
    - La Pampa, 1 ♂;
    - Perené, 2 ♂, 1 ♀;
    - Tulumayo, 1 ♀;
    - San Ramón, 1 ♂;
    - Chanchamayo, 1 ♀;

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[1] Specimens in Academy of Natural Sciences, Philadelphia.

[2] Specimens in Carnegie Museum, Pittsburgh.

Chuchurras, 1 ♀;
Pozuzo, 2 ♀;
Vista Alegre, 1 ♀[1];
"Upper Ucayali," 2 ♂;
"Lower Ucayali," 1 ♂;
Santa Rosa, 5 ♂, 3 ♀;
Sarayacu, 1 ♂;
Apayacu, 1 ♂, 3 ♀;
Puerto Indiana, 5 ♂, 3 ♀;
mouth of Río Curaray, 9 ♂, 3 ♀;
Yurimaguas, 1 ♀;
Jeberos, 5 ♂, 2 ♀;
Chamicuros, 2 ♂;
Uchco, 1 ♂;
Río Negro, 2 ♀;
Río Seco, 2 ♂, 2 ♀;
Nuevo Loreto, 1 (?).
ECUADOR:
(Zamora, Archidona, and lower Río Suno), 15.
BOLIVIA:
(Todos Santos, Vinto, Yungas of Cochabamba, and Pitiaguaya), 4.
COLOMBIA:
(Villavicencio, La Morelia, Quetame, Barrigon, Florencia, Buena Vista, and "Bogotá"), 13.
VENEZUELA:
(Mérida region), 7;
(Cocallar, Campos Alegre Valley, Salsipuede, Rincón San Antonio, and Cristóbal Colón), 12;
(Mt. Duida and Río Cassiquiare), 29;
(Orinoco and Caura valleys, Mt. Roraima, and Auyan-tepui), 56.
TRINIDAD: 27.
BRITISH GUIANA: 11.
DUTCH GUIANA: 14.
FRENCH GUIANA: 7.
BRAZIL:
(Rio Negro, Rio Uaupés, and Rio Surumú), 86;
Faro, 17;
Pará region, 7;
Rio Tocantins, 10;
Rio Xingú, 10;
Rio Tapajoz, 29;
Villa Bella Imperatríz, 3;
Rio Madeira (south to Calamá and Porto Velho), 28;
Teffé, 9;
Matto Grosso, Tapirapoan, 3;
Carapanha, 1 ♂ (type of "*duvida*").
T. p. violilavata.
ECUADOR:
(Esmeraldas to Santa Rosa), 18.
T. p. atripennis. -
COLOMBIA:
(Magdalena and Cauca valleys, west coast south to Los Cisneros, and Santa Marta region), 30.
PANAMÁ: 35.
COSTA RICA: 18.
NICARAGUA: 3.

Thraupis cyanocephala cyanocephala
(D'Orbigny and Lafresnaye)

A[*glaia*] *cyanocephala* D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., vol. 7, cl. 2, "Syn. Av.," p. 32—Yungas [Bolivia]; type from Enquisivi, Bolivia, in Paris Mus.

Peruvian birds are so nearly like Bolivian examples that separation is inadvisable. They have the back averaging a little yellower green (though often at the same time a little darker), the under parts a trifle darker, and the under tail-coverts deeper yellow with more frequent clouding in the centers of the feathers. Also, where the Bolivian birds appear to have a noticeably greenish area on the hind neck at the posterior border of the blue cap, the Peruvian birds, especially those from the northern parts of the country, usually have little or no trace of it. Nevertheless, these characters are not constant, and sharp delimitation is not present.

Most of these same distinctive features are developed in Colombia and the Mérida region of Venezuela in the birds heretofore grouped together under the name *auricrissa*, but in this case they appear to be of greater value than in Perú and Bolivia and it is possible to separate a recognizable subspecies on them as is discussed hereunder.

Peruvian records of *cyanocephala* are from Marcapata, San Miguel Bridge, Occobamba Valley, Auquimarca, Garita del Sol, Ninabamba, Cumpang, Cutervo, Tambillo, and Tabaconas. Tschudi's record from Lima (1846, Faun. Per., Aves, p. 206) is certainly an error unless individuals of the species had been brought to Lima and released in the fruit gardens thereabouts. Other workers around Lima never secured the bird at that locality, which is far out of the range of the species as otherwise known.

Thraupis cyanocephala annectens,
new subspecies

TYPE: From Cerro Munchique, Coast Range west of Popayan, Colombia; altitude 8325 feet. No. 110256, American Museum of Natural History. Adult male collected May 26, 1911, by W. B. Richardson.

DIAGNOSIS: Similar to *T. c. auricrissa* of "Bogotá," Colombia, and the Mérida region of Venezuela, but back darker green; under parts usually darker gray; under tail-coverts on average lighter yellow, always obscured by greenish centers of the feathers that often leave only relatively narrow yellow borders.

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[1] Specimen in Chicago Natural History Museum.

RANGE: Central and Western Andes of central Colombia.

DESCRIPTION OF TYPE: Top of head Grayish Violaceous Blue, extending over hind neck; forehead narrowly black, all but interrupted in mid-point; lores and a narrow circumocular ring black, extending over anterior part of auriculars and base of malar region; rest of sides of head and neck blue like the cap; back near Serpentine Green, with uropygium very little lighter. Throat, breast, sides, and flanks between Dark Plumbeous and Blackish Plumbeous; belly near Dark Plumbeous, even lighter in mid-line; thighs Lemon Chrome; under tail-coverts centrally Citrine margined with Aniline Yellow. Exposed outer surface of wings near Warbler Green but outer margin of outermost primary dark, and a small spot on the shoulder is near Light Cadmium. Bend of wing and under wing-coverts deep Lemon Chrome; inner margins of remiges near Wax Yellow (except toward tips of outer primaries and on tertials). Tail largely Dark Citrine, brighter and more greenish on outer margins and on middle rectrices. Bill (in dried skin) blackish, a little paler at lower base; feet dark brown. Wing, 89 mm.; tail, 67; exposed culmen, 12.5; culmen from base, 18; tarsus, 22.

REMARKS: Females similar to the males.

An occasional specimen from the Central Andes of Colombia shows a reduction of the amount of dark shading in the centers of the under tail-coverts, but in none is this area as clear yellow as in true *auricrissa* which, on the other hand, is never so heavily shaded as most of the examples of *annectens*. The color of the back similarly varies in some Central-Andean specimens, but distinction is possible on this basis in nearly all the examples at hand.

The small yellow patch on the shoulder is unequally developed in all specimens of *annectens* as well as in *auricrissa*, but it is of more frequent development than in *cyanocephala* where it rarely occurs. Some of the variability may be due to differences of preparation of the skins, since this patch is a continuation of the yellow under wing-coverts, part of which may sometimes be drawn over to the dorsal surface of the shoulder.

SPECIMENS EXAMINED

T. c. cyanocephala.—
BOLIVIA:
Incachaca, 5 ♂, 4 ♀;
Locotal, 1 ♂.
PERÚ:
Inca Mine, 1 ♂;
Oconeque, 1 ♂;
Santo Domingo, 6 ♂, 2 ♀;
Torontoy, 1 ♀;
San Miguel, 1 ♂;
Santa Rita, 1 ♂, 1 ♀;
Utcuyacu, 2 ♂, 1 ♀;
Chilpes, 2 ♂, 5 ♀;
Rumicruz, 2 ♂, 2 ♀;
Chinchao, 1 ♂[1];
Chugur, 2 ♂, 1 ♀;
La Lejia, 3 ♂;
San Pedro, 2 ♀;
Taulis, 1 ♀;
Levanto, 1 ♀;
Chachapoyas, 2 ♂, 1 ♀.
ECUADOR:
Pallatanga, 1 ♂;
Gualea, 1 ♂;
San Bartolo, 2 ♂;
Loja, 2 ♂, 1 ♀;
Guachanamá, 1 ♂.
T. c. annectens.—
COLOMBIA:
Cerro Munchique, 3 ♂ (incl. type), 1 ♀, 1 (?);
Cocal, 1 ♀;
Coast Range west of Popayan, 2 ♂, 1 ♀;
Salento, 1 ♂;
above Salento, 1 ♀;
Retiro, 1 ♂;
La Florida, 1 ♂, 1 ♀;
El Eden, 1 ♂, 5 ♀;
La Sierra, 1 ♂, 1 ♀;
Santa Elena, 3 ♂, 2 ♀, 1 (?);
Nóvita trail, 1 (?);
Medellin, 1 ♂, 1 ♀;
Antioquia, 1 (?).
T. c. auricrissa.—
COLOMBIA:
Gramalote, 1 ♂;
Palo Hueco, near Pacho, 1 ♂, 1 ♀;
Aguadita, 1 ♀;
El Roble, 1 ♂;
Choachi, 1 (?);
"Bogotá," 5 (?).

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[1] Specimen in Chicago Museum of Natural History.

Venezuela:
Mérida, 1 ♂, 5 (?);
Valle, 8 ♂, 2 ♀, 1 (?);
Escorial, 2 ♂;
Sierra, 1 ♂;
Culata, 1 ♂;
Ejido, 1 (?).

T. c. margaritae.
Colombia:
Santa Marta, Valparaiso, 1 ♂;
El Libano, 1 ♀.

T. c. olivi-cyanea.
Venezuela:
Galipan, 8 ♂, 1 ♀;
Las Cienagas de Aguilar, 2 ♂;
Silla de Caracas, 1 ♂;
Colonia Továr, 1 ♂, 2 (?);
Junquito, 1 ♂;
Junquito or Colonia Továr, 1 ♂, 2 ♀;
head of Chichiriwichi Valley, 1 (?).

T. c. subcinerea.—
Venezuela:
El Guácharo, 1 ♂, 1 (?);
Los Dos Rios, 1 ♀;
Los Palmales, 7 ♂, 1 (?);
hills of Quebrada Seca, 1 ♂.

T. c. busingi.
Trinidad:
Trinidad, 1 ♂, 1 (?);
Aripo, 10 ♂, 5 ♀.

Thraupis bonariensis darwinii
(Bonaparte)

Tanagra darwinii Bonaparte, 1838 (June), Proc. Zool. Soc. London, vol. 5, p. 121- Chile; S. W. Perú subst. by Berlepsch, 1912; type lost.

T[anagra] frugilegus Tschudi, 1844 (May), Arch. Naturgesch., vol. 10, no. 1, p. 286 Perú [fruit gardens of Lima; Tschudi, 1845]; Mus. Neuchâtel.

T[anagra] darwini laeta Berlepsch and Stolzmann, 1906, Ornis, vol. 13, p. 81 Cuzco, Perú; ♂; Mus. Frankfort.

A long series of specimens from various parts of Perú gives some support to the claim of "*laeta*" for recognition, but I am dubious about the full validity of the claim. The only character of any value is the size of the bill, and this is not always diagnostic. If the birds from the coast of northernmost Chile, the coast of Perú from Macate southward, and the upper part of the Marañón Valley are grouped together, it will be found that the exposed culmen ranges in length from 11.5 to 14 mm.; the culmen from base, 16 to 19.5. The birds from the Urubamba Valley, Chanchamayo, Huánuco, Chachapoyas, and Huancabamba regions of Perú and from Ecuador have the exposed culmen between 10 and 12.75 mm. in length; the culmen from base, 15 to 18. In the region of overlap, there are 17 out of 28 coastal and upper Marañón birds and 26 out of 34 of the remaining adult males. However, taking the mean of the overlapping measurements, there are only some 20 birds out of the 62 that cannot be placed definitely in one group or the other on this basis.

Nevertheless, without some supporting character, the separation of "*laeta*" is hardly justified. Wings and tail are even more broadly overlapping in lengths and are useless for this purpose. The colors of the various parts of the population appear to vary without any clear distinctions, and I am unable to recognize any subspecies in different parts of Perú on such basis. The adult male at hand with the lightest yellow under parts is from Chachapoyas; the most deeply colored males are from Utcuyacu, Huancabamba, and Cajabamba, Perú, and from Cumbaya, Ecuador, but other examples from these localities fail to support this tendency.

It is questionable whether we are justified in accepting Berlepsch's emendation of Bonaparte's given locality for *darwinii*. It is reasonably certain that the type was not obtained by the Beagle expedition as claimed by Bonaparte, since the account of the birds obtained on the expedition contains the statement that the only specimen of this species was obtained at Maldonado, Uruguay—of course an example of typical *bonariensis* to which Bonaparte's description does not apply. However, in spite of the fact that Peruvian specimens of ancient date are sometimes labeled as from Chile, it is not impossible that Bonaparte's specimen actually came from that country, in a limited portion of which *darwinii* exists. Consequently, the type locality may remain as Chile until more information becomes available on the actual source of Bonaparte's bird.

This tanager is widely distributed in the Andean regions of Perú and on the more southern part of the coast. Localities of record from which material has not been examined in the present study are Marcapata, Cosñipata, Huiro, Idma, Machu Picchu, Pisac, Santa Ana, Maraynioc, Pumamarca, Tamiapampa, La Merced, Tarma, Auquimarca, Huancavelica, Anco (sight), Lircay, Lucre, Moquegua, Arequipa, Araqueda, Succha, Chota, Cutervo, Callacate, Palca, Huanta, and Lima. Further extensions of the range are as far as northern Ecuador and western Bolivia.

In conjunction with the study of the present subspecies, the other forms of the species have been examined. It appears that *T. b. schulzei* (Brodkorb, 1938, Occas. Papers Univ Michigan, Mus. Zool., no. 367, p. 3—west of Puerto Casada, Paraguay) ranges west from Paraguay to northwestern Argentina from which region I have 32 examples that show the characters ascribed to this form, i.e., smaller size and more intense coloration on the under parts of the males than in typical *bonariensis*.

Birds from Bolivia, as far west as the Cochabamba region, combine the characters of the typical form and *schulzei* almost exactly, although the range is not an intermediate one. They are fully as large as *bonariensis* but have the under parts of the males almost as richly colored as in *schulzei*. In view of the impossibility of assigning them to either form, they may be described as new.

Thraupis bonariensis composita, new subspecies

TYPE: From Vinto, Province of Cochabamba, Bolivia; altitude 8000 feet. No. 138354, American Museum of Natural History. Adult male collected July 6, 1915, by Leo E. Miller and Howarth Boyle; original No. 12937.

DIAGNOSIS: Similar in size to *T. b. bonariensis* of southeastern Brazil and northeastern Argentina, but lower under parts more deeply colored; orange of breast deeper and carried farther posteriad; flanks less brownish. Compared to *T. b. schulzei* of [Paraguay and] northwestern Argentina, *composita* is larger, the blue of the head averages darker, and the orange colors of the lower under parts and rump are a little less intense.

RANGE: Eastern and central Bolivia.

DESCRIPTION OF TYPE: Forehead, lores, circumocular space, malar apex, and point of chin black; rump deep Cadmium Orange; upper tail-coverts olive brown, broadly margined with Orange Citrine. Breast deep Cadmium Orange with a black area on each side continuous with the mantle; the orange is continued posteriorly, becoming paler and more yellowish, near Lemon Chrome, on the lower belly; posterior flanks slightly tinged with Old Gold; thighs whitish; shorter under tail-coverts near Apricot Yellow; longer ones paler. Wings and tail blackish, with outer margins Light Columbia Blue; outer rectrices with a terminal whitish spot and a subterminal black area; axillars and inner under wing-coverts with pale greenish margins; outer ones with somewhat bluish margins. Maxilla (in dried skin) blackish; mandible pale; feet light brown. Wing, 97 mm.; tail, 74; exposed culmen, 12; culmen from base, 16.8; tarsus, 22.

REMARKS: Females not certainly distinguishable from those of *bonariensis* but possibly averaging darker in general coloration; size larger than that of female *schulzei*.

The measurements in *composita* are more definitive than those found in the different parts of the population of *darwinii*. Thirty adult males of *bonariensis* have the wing 89–96 mm. in length (average, 92.9); 17 *schulzei*, 84.5–91.2 (average, 88.2); 19 *composita*, 90–97 (average, 93.6). The tails in the three respective forms are 65.5–74.2 (average, 72.9); 64–69 (average, 67.8); and 68–74 (average, 71.5). Only five *composita* males and three *schulzei* males overlap in wing measurement, and the figures are but three and one, respectively, if the mid-point of the overlap is taken as the line of demarcation. Between *schulzei* and *bonariensis*, there is an overlap of three *schulzei* and two *bonariensis*, or one and one, respectively, from the mid-point. With regard to the tail, there are two *composita* males and six *schulzei* in the overlapping sector, or but one and one below and above the mid-point. There are, however, nine *schulzei* and 11 *bonariensis* with overlapping tail measurements, or seven and 10, respectively, on the wrong side of the mid-point of the overlap.

Several specimens of *bonariensis* males have the black mantle feathers margined, in varying degree, with olive. Many specimens of *bonariensis*, *schulzei*, and *composita* have a band of olive separating the black of the mantle from the orange of the rump, but many lack it. Some females (if the specimens are correctly sexed) have as much blue on the head as certain females of *darwinii*, although other examples of the Peruvian form reach an extreme not covered by the other three subspecies. All these characters, however, are indicative of the close relationship of all forms.

Specimens Examined

T. b. bonariensis.—
- ARGENTINA:
  - La Plata, 1 ♂, 2 ♀;
  - La Soledad, 3 ♂, 1 ♀;
  - Buenos Aires, 1 ♂;
  - Conchitas, 1 ♀;
  - Barracas al Sud, 1 ♂, 1 ♀;
  - "Argentina," 1 ♂.
- BRAZIL:
  - Rio Grande do Sul (Palmares, Sinimbú, Arroyo del Rey, Lagôa dos Patos, São Lorenzo, São Francisco de Perla, Candiota, Lagôa Mangueira, Tahyn, Quinta, Santa Cruz, Sapyranga, and Santa Victoria), 33 ♂, 23 ♀, 2 (?).
- URUGUAY:
  - Jaquarão River, 1 ♂.

T. b. schulzei.—
- ARGENTINA:
  - Rosario de Lerma, 6 ♂, 2 ♀;
  - Suncho Corral, 4 ♂, 1 ♀;
  - Embarcación, 5 ♂, 1 ♀;
  - Tucumán, 2 ♀;
  - San Pablo, 1 ♂;
  - Avia Terai, 1 ♀;
  - Lavalle, 1 ♀;
  - Fuente de Andagala, Catamarca, 2 ♂;
  - Mendoza, 2 ♂, 1 ♀.

T. b. composita.—
- BOLIVIA:
  - Vinto, 4 ♂ (incl. type);
  - Parotani, 2 ♂, 2 ♀;
  - Tujma, 1 ♂;
  - Tarata, 1 ♂, 1 ♀;
  - Arque, 1 ♂;
  - Valle Grande, 1 ♂;
  - Olgin, 1 ♂;
  - Pulque, 2 ♂;
  - Chilon, 7 ♂, 1 ♀;
  - Río Pilcomayo, 2 ♂;
  - Río Cachimayo, 1 ♂, 1 ♀.

T. b. darwinii.—
- PERÚ:
  - Cuczo, 1 ♀;
  - Calca, 1 ♂;
  - Tinta, 1 ♂, 1 ♀;
  - Chospiyoc, 1 ♀;
  - San Miguel, 1 ♂;
  - Vitor, 7 ♂, 2 ♀;
  - Moquegua, 1 ♂;
  - Sayan, 1 ♀;
  - Huaral, 10 ♂, 2 ♀;
  - Huacho, 6 ♂, 2 ♀;
  - Matucana, 1 ♀[1];
  - Acobamba, 1 ♀;
  - Utcuyacu, 7 ♂, 4 ♀;
  - Chinchao, 1 ♀[1];
  - Panao, 1 ♀[1];
  - Huánuco, 4 ♂[1], 2 ♀[1];
  - Cullcui, 2 ♂[1], 3 ♀[1];
  - Cumpang, 1 ♀;
  - Cajabamba, 3 ♂;
  - Huamachuco, 1 ♂, 2 ♀;
  - Cajamarca, 3 ♂, 1 ♀, 4 ♂[1], 1 ♀[1];
  - Hacienda Llagueda, 2 ♂[1], 1 ♀[1];
  - Macate, 4 ♂[1];
  - Huancabamba, 5 ♂, 3 ♀;
  - Sondorillo, 2 ♂, 2 ♀;
  - Chachapoyas, 4 ♂, 1 ♀;
  - San Pedro, 1 ♂, 1 ♀;
  - Palambla, 1 ♂.
- CHILE:
  - Putre, 1 ♂[1], 3 ♀[1];
- ECUADOR:
  - (El Paso, Valle Tumbaco, Valle Cumbaya, Mt. Chimborazo, Guapilo, Ibarra, Cayambe, Río Napo, Chivinda, Quito, and "Ecuador"), 23 ♂, 12 ♀, 2 (?)

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[1] Specimens in Chicago Natural History Museum.

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STUDIES OF PERUVIAN BIRDS. NO. XLIX[1]

NOTES ON *FREDERICKENA* AND *OCHTHOECA*

BY JOHN T. ZIMMER

I am grateful to Mr. Rodolphe deSchauensee and Mr. James Bond of the Academy of Natural Sciences of Philadelphia, and to Mr. Robert T. Moore of Pasadena, California, for important material used in the following study. I am also grateful to the late Dr. C. E. Hellmayr for critical notes on certain material in Vienna without which the evaluation of other data would not have been possible.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

Frederickena unduligera unduligera (Pelzeln)

Thamnophilus unduliger PELZELN, 1868, Orn. Bras., vol. 2, pp. 75, 139—Marabitanas (Rio Negro) and S. Boaventura (Rio Icanna), Brazil; cotypes in Vienna Mus.

There appears to have been general acceptance of the identity of members of this species from all parts of its range, but the differences exhibited by the specimens from different localities that I have examined have led me to question this arrangement. Unfortunately, I have been unable to see topotypes of Pelzeln's form since Pelzeln's four birds, in the Vienna Museum, appear to be the only ones that have ever been taken in that general region.

However, several years ago, when I first attacked the problem, I wrote to Dr. Hellmayr, then in Vienna, to give me a detailed account of the characters of the cotypes. This he was kind enough to do. His descriptions show little agreement between the Rio Negro birds and those of the foothills of the Andes and the south bank of the Rio Amazonas.

Dr. Hellmayr wrote me as follows: "The females are pretty nearly alike apart from several slight variations to be noted hereafter. Both have the top of the head and crest somewhat brighter than 'hazel,' but the feathers of these parts are by no means *barred*, but merely have a narrow dusky shaft streak; the light bands on the hind-neck and back are between tawny and ochraceous-tawny, somewhat duller in the Rio Icanna female, the rufescent and black bars being about the same width; the under parts are somewhat duller, nearer 'buckthorn brown,' deepening into 'ochraceous-tawny' on foreneck, sides and flanks. Aside from the throat, which is rather irregularly marked with black and buffy or whitish, the whole under surface is closely and regularly barred with blackish down to the tail-coverts. The female from Rio Icanna is slightly duller above, the light throat-markings are whitish rather than buff, and the middle line of the abdomen is paler, more buffy than in the Marabitanas bird. These variations are quite insignificant.

"The males, too, show very little variation. Both are regularly *barred* with grayish above, these grayish bars being much narrower than the rufous ones in the female sex; the feathers of the pileum have two concentric grayish markings, continuous in the Rio Icanna bird, nearly broken into spots in the Marabitanas male. The latter is more marked below, even throat and foreneck being speckled with grayish white, whereas these parts in the Rio

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[1] Earlier papers in this series comprise American Museum Novitates nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, 917, 930, 962, 963, 994, 1042, 1043, 1044, 1045, 1066, 1095, 1108, 1109, 1126, 1127, 1159, 1160, 1168, 1193, 1203, 1225, 1245, 1246, and 1262.

Icanna male are predominantly black, only with some scattered white (subapical) dots here and there. Breast and belly are heavily speckled, spotted and marked with concentric grayish bars, the whole giving a very irregular effect; the Rio Icanna bird again is less strongly marked, particularly along the middle line."

I quote the description in full since I have used it as the basis for my discussions of comparative characters in the new forms that I describe below. I would call attention particularly to the unbarred crest-feathers, the completely barred under surface, and the generally dull brown coloration of the females. This combination of characters is not found in any of the females that I have examined from other regions, and is sufficiently distinctive to support my belief that none of them can be referred to true *unduligera*.

I consider the resemblances of this species to *Frederickena viridis* greater than those to *Mackenziaena leachii* and *severa* and place the species accordingly.

I can see no application of the name *brevirostris* (Lafresnaye, 1844, Rev. Zool., vol. 7, p. 82) to this species as was suggested by Hellmayr (1924, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 3, p. 44, footnote).

Frederickena unduligera diversa, new subspecies

TYPE: From Orosa, south bank of Río Amazonas, Perú. No. 231636, American Museum of Natural History. Adult female collected October 7, 1926, by Carlos Olalla and sons.

DIAGNOSIS: Similar to *F. u. unduligera* of the Rio Negro, Brazil, but females with under parts more brightly colored (orange-ochraceous instead of near buckthorn brown), anteriorly marked with blackish spots and crescents but not "barred," and posteriorly largely unmarked (not barred throughout). Male not certainly different from *unduligera* but possibly with a greater extension of unmarked black on the breast.

RANGE: Eastern and southeastern Perú, south of the Amazon.

DESCRIPTION OF TYPE: Top of head crested, with the longest feathers 35 mm. in length; forehead Sanford's Brown × Auburn, with blackish shafts; crown and back of head darker, Auburn, with black shaft-streaks widening at intervals into ill-defined spots; mantle near Saccardo's Umber, a little warmer anteriorly, a little grayer posteriorly, and strongly barred with black, with the black bars somewhat lunulate and nearly as wide as the paler interspaces; uropygium grayer, near Buffy Brown, only a little less strongly barred than the crown and narrowly freckled and barred with black; chin, throat, and breast Amber Brown × Sudan Brown with small sagittate spots and narrow lunules of blackish, becoming obsolete on the lower breast and upper belly; belly lighter, Mars Yellow × Xanthine Orange, almost unmarked; flanks darker, Dark Amber Brown, with traces of narrow dusky bars; under tail-coverts like the belly. Remiges largely dark Hair Brown; outer primaries with a row of ochraceous spots on the outer margins; inner primaries and secondaries with these marginal spots darker but more extensive and presenting a pattern of warm brown crossed by narrow blackish bars; tertials near the color of the mantle with broad dusky bars and lunules; upper wing-coverts much like the mantle; inner margins of remiges with warm buffy spots separated by dark interspaces; under wing-coverts Sanford's Brown. Tail black with extensive gray and white markings in the form of broad lunules, spots, and bars, grayest on the median feathers and outer webs of the remainder, and whitest on the inner webs; each rectrix narrowly tipped with white. Maxilla (in dried skin) blackish brown; mandible lighter; feet brown. Wing, 108 mm.; tail, 91; exposed culmen, 24; culmen from base, 31; tarsus, 36.

REMARKS: Male from Sarayacu, Perú, with upper parts black, finely vermiculated with gray; throat and broad pectoral area black with little trace of grayish markings; rest of under parts like the back but the gray vermiculations broader. Remiges blackish with dull grayish spots on outer margins of primaries and secondaries; tertials about like the back; upper wing-coverts like the back; inner margins of remiges with dull whitish indentations; under wing-coverts finely barred with white and dull black. Tail black, with dull grayish freckling on outer margins, at least of most of the feathers (median rectrices missing in this example).

A male from Lagarto, upper Ucayali, is somewhat different from the Sarayacu male and shows a pronounced approach toward a male from the Rio Madeira, belonging to a form described below. It has the gray vermiculations of the back and tail widened into relatively broad but uneven bars and lunules (narrower than the black interspaces), the throat and breast noticeably speckled with grayish white, and the lower under parts more broadly speckled and barred with ashy white. Compared with the Rio Madeira male, the general color is darker and the pale bars and lunules are narrower and less regular, but there is noticeable similarity at first glance.

Another male from Lagarto, however, although it is not in fully adult dress, shows the markings of the Sarayacu male on those adult feathers that are already in place. The immature plumage of the upper parts and lower under parts is prominently barred with black and rufous while the throat and breast, where not clear black, are characterized by sagittate rufous and black markings.

Two females from southeastern Perú are a little more deeply colored than the type but are similar in pattern.

Records from Jeberos and Chamicuros presumably belong to this form. Taczanowski (1884, Ornithologie du Pérou, vol. 2, p. 2) describes a female (from Jeberos) as having the dark markings of the under parts relatively weak, with the middle of the belly only feebly marked. This character points to *diversa,* as does the geographic position of the localities.

Frederickena unduligera fulva,
new subspecies

Type: From Río Suno, above Avila, eastern Ecuador. No. 179224, American Museum of Natural History. Adult female collected April 21, 1923, by Carlos Olalla and sons.

Diagnosis: Similar to *F. u. unduligera* of the Rio Negro, Brazil, but females more fulvous and with crest strongly barred. Females differ from those of *F. u. diversa,* described above, by much darker and more fulvous coloration and by the heavy blackish barring of the entire under surface.

Range: Tropical Zone of the eastern side of the Andes in eastern Ecuador and southeastern Colombia.

Description of Type: Front light Chestnut with black shafts; crown and crest dark Chestnut, strongly barred with blackish; back rather uniformly barred with black and Cinnamon Brown (anteriorly) to Olive Brown (posteriorly). Under parts near Sanford's Brown × Auburn, a little paler on the belly, and marked throughout by black bars and lunules, narrower than the dorsal bars. Wings with exposed outer surfaces crossed by blackish and light Auburn bars; under wing-coverts Ferruginous × Burnt Sienna. Tail black, crossed by bars of Hair Brown, broadest on the median rectrices and the outer webs of the other feathers. Maxilla (in dried skin) blackish; mandible paler; feet brown. Wing, 106 mm.; tail, 86; exposed culmen, 25.25; culmen from base, 34.25; tarsus, 35.

Remarks: Male as described for the Sarayacu male of *diversa,* but breast less extensively pure black—lower portion and sometimes lower throat also freckled with ashy white.

There are no records from Perú that are assignable to this form, although there is every possibility that it occurs somewhere in part of that country north of the Amazon.

Frederickena unduligera pallida,
new subspecies

Type: From Rosarinho (Lago Sampaio), left bank of Rio Madeira, Brazil. No. 281873, American Museum of Natural History. Adult female collected June 28, 1930, by the Olalla brothers.

Diagnosis: Similar to *F. u. unduligera* of the Rio Negro, Brazil, but female paler and less heavily marked, with the lower under parts nearly uniform. Compared with *F. u. diversa*, the female is paler and less warmly colored and the dark bars of the upper surface are less heavy and less defined. Compared with *F. u. fulva*, the female is much paler and less heavily marked, with the lower under parts uniform instead of barred. The chest is more uniform than in females of *diversa* and *fulva*, possibly more than in *unduligera*. Compared with the males of *diversa* and *fulva*, the male of the present form has the grayish white bars broader and more prominent.

Range: Known only from the type locality.

Description of Type: Top of head and crest nearly uniform dark Sanford's Brown, with traces of dusky shaft-lines at the tips of the longest feathers; mantle near Saccardo's Umber, with ill-defined blackish lunules not always reaching the margins of the feathers; lower back grayer, near Hair Brown, similarly marked with dark bars. Under parts near Clay Color or Cinnamon Buff medially, darker on the breast and near Saccardo's Umber on the lower flanks; throat and breast marked with narrow, blackish, sagittate loops, becoming less conspicuous on the upper belly and disappearing on the lower belly. Outer margins of remiges crossed by bars of light Russet and dusky brown. Tail dull blackish with inner pair of feathers and outer webs of the others marked by broad indentations of Hair Brown, often broader than the blackish interspaces; inner webs, except of inner pair of rectrices, with crescentic cross-bars of whitish, for the most part not reaching the internal margins of the feathers. Maxilla (in dried skin) blackish; mandible paler; feet light brown. Wing, 98 mm.; tail, 81.5; exposed culmen, 24; culmen from base, 30; tarsus, 34.75.

Remarks: Male with the same general pattern as the males of the other forms but with the following differences. The gray vermiculations of the upper surface are broadened into distinct bars on the back, nearly as wide as the black interspaces; the feathers of the top of the head, including the crest, have their margins supplied with quite distinct gray spots; the sides of the head and the throat have prominent white dots; the breast is more prominently vermiculated with gray than the belly of *diversa* or *fulva*, and the belly has the gray or ashy white bars rather distinct and as broad as the black areas. Similarly, the grayish barring of wings and tail is broader, and these markings on the inner webs of all but the innermost rectrices are whiter.

Specimens Examined

F. u. diversa.—
  Perú:
    Orosa, 1 ♀ (type);
    Lagarto, 2 ♂;
    Astillero, 1 ♀;
    Huacamayo, 1 ♀[1].
F. u. fulva.—
  Ecuador:
    Río Suno, above Avila, 1 ♀ (type);
    lower Río Suno, 1 ♂;
    Río Suno, 1 ♂[2].
  Colombia:
    La Morelia, 1 ♂, 3 ♂[1], 2 ♀[1], 1 (?)[1].

FURTHER COMMENTS ON *OCHTHOECA RUFI-PECTORALIS*

In a previous review of this species (1942, Amer. Mus. Novitates, no. 1203, pp. 14–15), I maintained a still earlier assignment of material from the Chachapoyas region to *centralis*, in view of some indications of intermediacy between that form and *obfuscata*. I believed, also, that the canyon of the Marañón formed the most likely barrier by which to delimit the two forms in that region. Additional material from northern Perú, kindly submitted to me by Mr. de Schauensee of the Academy of Natural Sciences of Philadelphia, places a weight of evidence in another direction and a new analysis is required.

From a reëxamination of the augmented series, it now appears necessary to assign all the birds from the Chachapoyas region and the records from the Chamaya Valley, between the Marañón and the Western Andes, to *obfuscata*. There is still a certain amount of intermediacy with *centralis* but no complete agreement with that form, while there is frequent agreement with the series from west of the Western Andes from Taulis northward.

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[1] Specimens in Academy of Natural Sciences, Philadelphia.

[2] Specimen in collection of Robert T. Moore.

On the other hand, *centralis* appears to range northward in the Marañón Valley as far as Patás and likewise crosses that river and the Western Andes to the slopes above the Santa Valley at Yánac. The warmth of color in the back of the birds from these two localities, not heretofore examined by me, is quite in contrast to the grayer color of the birds from farther north. The rufous color of the breast is noticeably deeper in *centralis*.

With this rearrangement, the specimens and references from Tambillo, Palto, Cutervo, Molinopampa, Tamiapampa, El Tambo, Chugur, Taulis, and Paucal should be assigned to *obfuscata*, to which may be added three males and one female from Chira, and three males and three females from El Tambo in the Academy of Natural Sciences of Philadelphia. To *centralis*, there are only the type and paratypes from Panao and near Huánuco, to which may be added one male from Patás and two males and females from Yánac, of which one male from Yánac is now in the American Museum collection; the remainder are in the Academy of Natural Sciences of Philadelphia.

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ON A SUPPOSED NEW PSEUDOSUCHIAN FROM UPPER TRIASSIC SAURISCHIAN-BEARING RED BEDS OF LUFENG, YUNNAN, CHINA[1]

BY CHUNG-CHIEN YOUNG[2]

INTRODUCTION

The upper Triassic Red Beds of Lufeng, Yunnan Province, China, have yielded a rich saurischian fauna, associated with *Bienotherium yunnanense*, a form intermediate between reptiles and mammals, and closely related to *Tritylodon*. In addition, a single piece of fossil has been found which belongs to Reptilia other than Saurischia. This is the anterior part of a pair of lower jaws, rather small in size, apparently a pseudosuchian, as I have previously announced in a very brief way (Young, 1940). It will be more fully described in the present note.

I wish to express my sincere thanks to Dr. Edwin H. Colbert, Curator of Fossil Amphibians and Reptiles of the American Museum of Natural History, for all the facilities given to me by himself and his colleagues, during my stay in this Museum. The drawings were prepared by Mr. John C. Germann, to whom I am also deeply indebted. To Dr. Barnum Brown and Dr. Charles C. Mook I wish also to express my indebtedness for discussions regarding this unique specimen, during the course of the present study. It is also my great pleasure to thank Mr. Albert E. Parr, Director of the American Museum of Natural History, for giving me an opportunity to publish the present note in this series.

DESCRIPTION

PSEUDOSUCHIA

PLATYOGNATHUS, NEW GENUS

With the diagnosis of the type species, *Platyognathus hsui*.

Platyognathus hsui, new genus and species

TYPE: Cenozoic Research Laboratory No. V. 71. The anterior part of a pair of lower jaws, with 11 alveoli on the left side, 12 alveoli and one canine-like tooth with the tip damaged, on the right side.

HORIZON AND LOCALITY: Dark Red Beds of the upper Triassic age from Huangchiatien, about 1 kilometer north of Shawan, Lufeng, Yunnan Province, China. Collected by C. C. Young and M. N. Bien in 1939. (Bien, 1940.)

DIAGNOSIS: Pseudosuchian of small size. Lower jaw short and flat in anterior part. Tip blunt and slightly expanded immediately behind the tip. Behind a weak constriction posterior to the canine-like tooth, the jaw expands considerably laterally. The teeth were thecodont, as judged by the size and position of the alveoli. Anterior teeth small, pointing anteriorly. At least two canine-like teeth directed obliquely and anteriorly. The cross section of the preserved tooth is irregularly octangular in outline. Posterior teeth subequal in size, being in vertical position with the axis of the jaw.

DESCRIPTION: Both jaws are firmly coossified. No trace of sutures can be seen either from the top or from below. In ventral view, a broad longitudinal groove represents the symphysis but is stopped by a nearly transverse shallow depressed groove. The bony part anterior to the groove may represent a predentary bone, but as there is no visible suture between them, I consider it only a prolongated part of the dentary. The anterior lateral part of the left side is partly damaged without, however, obscuring the essential outline of the jaw. The bone surface is finely granulated.

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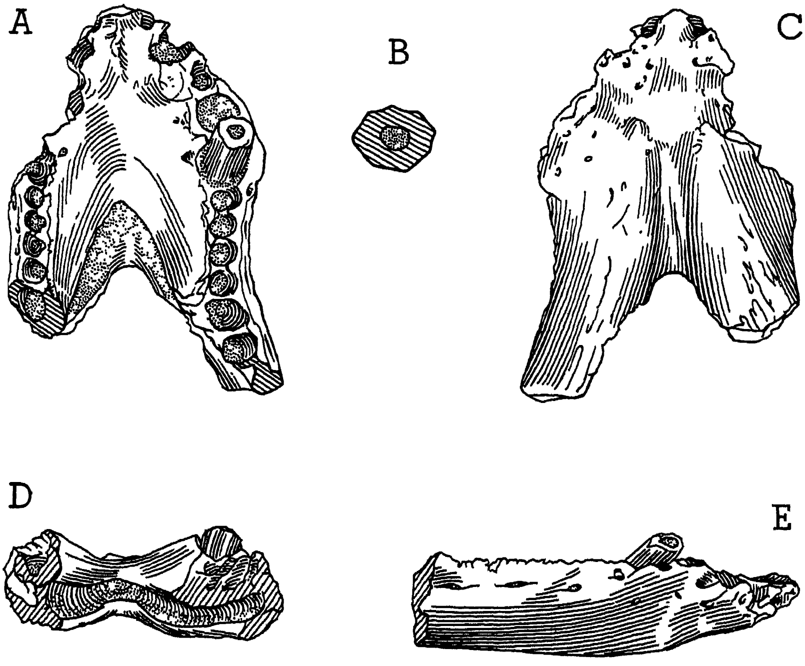

Fig. 1. *Platyognathus hsui*, new genus and species. Incomplete pair of lower jaws, shown from above (A), from below (C), from behind (D), and from the right side (E). Twice natural size. The cross section of the only preserved tooth (B), is shown four times natural size.

The jaw is low and flat, especially the anterior part, and very much depressed in dorsoventral direction. At the anterior tip, it forms a rather blunt rounded outline. A slight expansion is observable at the part beside the larger canine-like teeth. Then there is a length of about 8 mm. posteriorly which is slightly, or even weakly, constricted, followed by a considerable expansion posteriorly and laterally, as clearly indicated by the right side which is the most completely preserved. Both at the ventral side of the tip, near the marginal border, and at the lateral sides below the tooth row, a number of small foramina are developed, for blood and nerve canals. The posterior edge of both jaws, which forms an acute angle of about 45 degrees, is marked by a broad and deep furrow for attachment of the cartilaginous splenial. Near the anterior margin of the jaws, looking from the top, a short (2 mm. long, only) but distinct ridge is developed at the median line. Posterior to that, the jaws form a broad and shallow trough.

The teeth are represented by a single one, of which the tip is unfortunately broken. It is the second large tooth, having a diameter of about 2 mm. The transverse diameter slightly exceeds the anteroposterior one. The tooth is densely covered by enamel. The cross section of the tooth is clearly polygonal in outline, being roughly octangular, with the comparatively longer measurements on the inner and posterior sides. It is directed distinctly anteriorwards.

Anterior to this tooth, five alveoli can be seen on the right side. The left side must have had the same number of teeth, although borders of some of the alveoli are partly damaged. The alveolus immediately in front of the described tooth is about the same size as the alveolus of this tooth. The others rapidly decrease in size anteriorly. The medial two are the smallest and visible only from the anterior aspect of the jaws. Judging from the position of the alveoli, all these teeth are directed more or less straight anteriorly. Posterior to this broken tooth, there are four alveoli ranging in a straight line and subequal in size. Then the tooth row starts to bend laterally, with two complete alveoli and the anterior part of the following one showing on the right side, and one on the left side. All the alveoli of the "post canine-like teeth" show the position of the teeth directed vertically upwards. Altogether, there are 12 alveoli and one tooth preserved on the right side, and 11 alveoli on the left side.

MEASUREMENTS

Maximum preserved length of jaw, from the tip to the posterior breakage on the right side	27 mm.
Median symphyseal length (from above)	14 mm.
Median symphyseal length (from below)	18 mm.
Breadth of jaws, across the posterior side of the preserved tooth (from below)	15.5 mm.
Posterior breadth of jaw (estimated), at the posterior breakage of the right jaw	20 mm.
Height of right jaw behind the tooth	5 mm.
Transverse diameter of the tooth	2 mm.

DETERMINATION AND SYSTEMATIC POSITION: Although the specimen is fragmentary, the preserved part displays a series of important features. The flatness of the jaw, the anterior direction of the anterior canine teeth, the octangular outline in cross section of the canine-like tooth, the relatively short tip of the jaw, and the abrupt lateral bending of the jaw behind the tooth are the most important of these. In the shortness and flatness of the jaw, the present form excludes any further suggestion of close relationship with most of the primitive Pseudosuchia of South Africa, such as *Notochampsa* (Broom, 1904), *Sphenosuchus* (Broom, 1915, 1927), *Proteorosuchus* (Broom, 1915), *Erythrochampsa* (van Hoepen, 1915), and *Pedeticosaurus* (van Hoepen, 1915). All of them are much larger in size and possess a long, compressed, and sharply pointed snout. The interesting specimen from the upper Triassic of Arizona, in North America, described by Dr. Barnum Brown as *Protosuchus richardsoni* (Brown, 1933), the type of which I have had the opportunity of examining, differs in the same features of the jaw, although in size it is closer to the Chinese form. The Pseudosuchia in the upper Triassic period are so poorly known that I fail to find any which could be closely compared with the present form. I propose to name the Chinese form *Platyognathus hsui*, new genus and species, in view of the important features described above. It represents the first and oldest known pseudosuchian found in China. The generic diagnosis has already been cited above. The species name is dedicated to Mr. T. Y. Hsu of the National Geological Survey of China, who contributed so much to the knowledge of the Triassic stratigraphy and marine invertebrate fossils of that period in China, and who recently lost his life while working in the field in Kweichow Province.

In many respects, especially the shape of the teeth and the rounded and short tip of the symphyseal part, as well as the sudden expansion in the posterior part of the jaw, and, above all, the depressed nature of the symphysis, the specimen does not appear closely connected with the problem of the origin of crocodiles. The skull of *Platyognathus* must have been triangular and short, with a rounded short snout, as can be deduced from the shape of the lower jaw. The forward bending of the anterior teeth, in combination with the flat shovel-like lower jaw, is very impressive.

Considering the peculiarities found on this specimen, it is probable that we may even be dealing with an entirely new family, the exact systematic position and relationships of which, within the scope of primitive crocodiles and pseudosuchians, must await further collection of new specimens.

Platyognathus hsui is derived from the dark Red Beds of the lower Lufeng series of Lufeng. The associated forms so far known are: Chelonia, indet.; *Sinosaurus triassicus; Lukousaurus yini, Yunnanosaurus huangi, Lufengosaurus huenei, Lufengosaurus magnus* (all saurischians), and *Kumina minima* (probably an allied triconodont form), most of which are known to be of uppermost Triassic age. Although there is a rich fossiliferous level at least 300 meters below the *Platyognathus* level, with the type of *Lufengosaurus huenei, L. magnus*, and *Bienotherium yunnanense*, the purplish Red Beds of Bien, the upper level seems still to belong to the same faunistic unit, as proved by the same saurischians. So far, no *Bienotherium* has been found from the upper level.

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NEW NEOTROPICAL FULGOROIDEA

BY RONALD GORDON FENNAH[1]

Six monotypic species are described as new in this paper, and for the reception of four of them it has proved necessary to erect a new genus in each of the following families: Cixiidae, Dictyopharidae, Tropiduchidae, and Lophopidae. The specimens on which the descriptions are based are in the collection of the American Museum of Natural History, having been taken in Brazil, Peru, and the Canal Zone.

One specimen, described below in the new genus *Protachilus*, proved difficult to place with any certainty, and its present inclusion in the Dictyopharidae must be considered tentative pending discovery of further evidence of affinity that may be obtainable from a study of the male genitalia. Regarding the lophopid, it is to be noted that in 1931, Muir (Proc. Hawaiian Ent. Soc., vol. 7, p. 476) described a new genus, *Carrionia*, in this family and transferred *Hesticus* Stål from the Dictyopharidae, and indicated that these two genera were the only representatives of the Lophopidae in South America. The Peruvian genus described below is accordingly the third to be recorded from the Neotropical region.

Cixiidae

PARACIXIUS, NEW GENUS

Vertex at greatest length longer than broad (2.2 to 1), projecting before eyes for half their length, anterior margin transverse, lateral margins carinate, an oblique transverse carina arising near anterior level of eyes and reaching anterior margin at middle, forming an elongate areolet on each side, posterior margin angularly excavate, disc deeply sunken; frons in middle line as long as wide, width at base one-third width at widest part, lateral margins carinate, sinuate, distally ampliate, median carina forked in basal fifth, median ocellus present, a trace of an elongate fenestra sublaterally at level of antennae; clypeus medially carinate. Pronotum one-third as long as vertex in middle, median carina distinct, lateral carinae curved anteriorly distally, approximately following hind margin of eyes, posterior margin deeply angularly excavate, curved cephalad at sides; mesonotum as long as broad, disc shallowly convex, distinctly tricarinate. Post-tibiae armed with four spines, two at base minute, two larger near middle.

Tegmina with Sc+R and M arising separately from basal cell, Sc+R forked a little basad of middle, M forked about level of stigma, Cu_1 forked at level of middle of claval suture; six subapical cells, Sc with three apical cells, R with three, M with five, Cu_1 with three; calval veins uniting in basal third of clavus. Wings with Sc simple, R with one fork, M with one, Cu_1 with two.

Pygofer medially excavate on ventral posterior margin, with a short medioventral process. Anal segment long, anal foramen near apex.

GENOTYPE: *P. armiger*, new species.

Paracixius armiger, new species

Figures 1–8

MALE: Length, 4.5 mm.; tegmen, 5.5 mm.

Frons pale fuscous, clypeus testaceous, vertex except on lateral carinae, anterior portion of genae, pronotum before lateral carinae, mesonotum anteriorly and in a large patch on each lateral field, and sclerites of abdomen fuscous; lateral carinae of vertex, pronotum basad of lateral carinae, mesonotum medially and basally,

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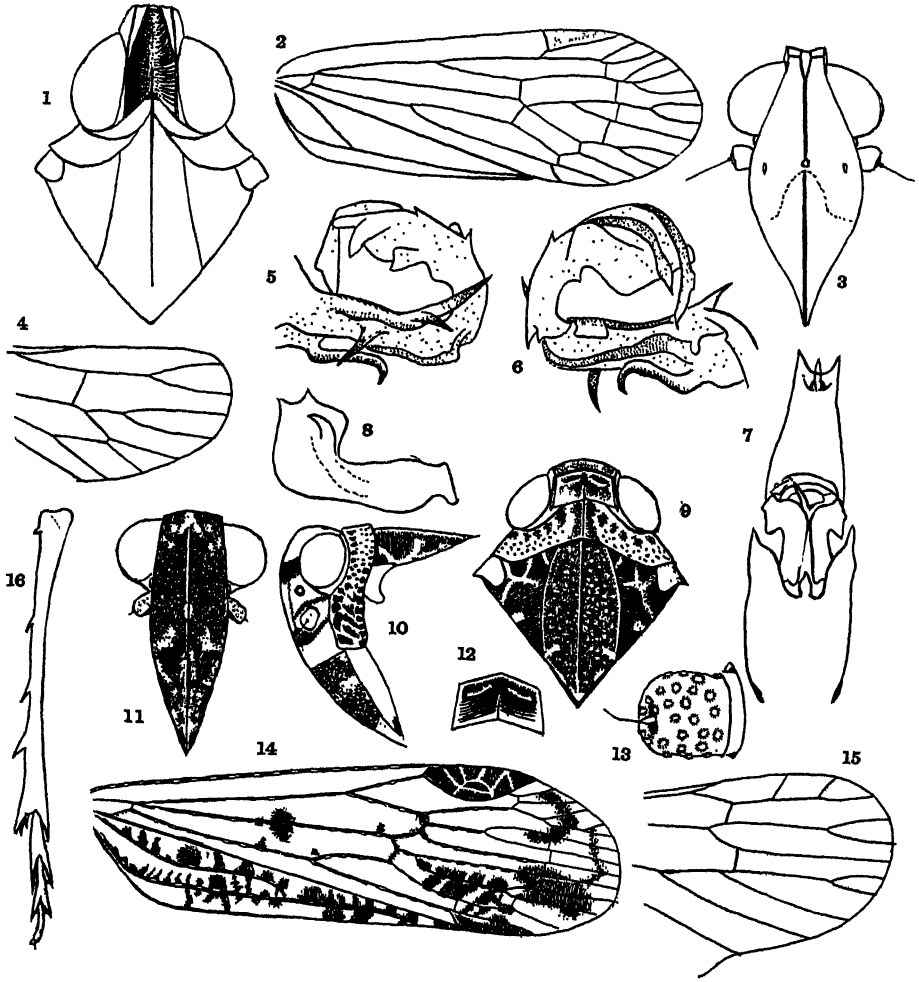


Fig. 1. *Paracixius armiger*, new species, head and thorax, dorsal view.
Fig. 2. Idem, right tegmen.
Fig. 3. Idem, head, frontal view.
Fig. 4. Idem, apical portion of wing.
Fig. 5. Idem, aedeagus, left side, ventrolateral view.
Fig. 6. Idem, aedeagus, right side, lateral view.
Fig. 7. Idem, pygofer, genitalia, and anal segment, not quite mid-ventral view.
Fig. 8. Idem, left genital style, lateral view on inner surface.
Fig. 9. *Protachilus rex*, new species, head and thorax, dorsal view.
Fig. 10. Idem, head and pronotum in profile.
Fig. 11. Idem, head, frontal view.
Fig. 12. Idem, vertex.
Fig. 13. Idem, antenna.
Fig. 14. Idem, right tegmen.
Fig. 15. Idem, apical portion of wing.
Fig. 16. Idem, hind tibia and tarsus, dorsal view.

sternum and legs testaceous to stramineous. Head and thorax sparsely powdered emerald green.

Tegmina and wings hyaline, stigma pallid except narrowly along inner margin, where fuscous; veins fuscous.

Pygofer fairly long, posterior ventral margin deeply excavated in middle, with a short subtriangular horizontal process medially. Anal segment long, porrect, fairly broad, dorsally moderately convex, sides very shallowly convex basally, tapering distally, anal foramen close to apical margin, apical margin excavate, lateral angles pointed, telson short and narrow. Aedeagus straight with a spiniferous flagellum distally curved dorsally and to right, looping to point ventrally at its tip; a stout spine, decurved at tip, arising on right side at base of aedeagus, a vertical spine directed ventrally on ventral side of aedeagus about middle, two stout spines dorsally on left side, one much longer than the other; flagellum with two short spines on upper margin and a pair of subparallel sclerotized curved bands near and at apex. Genital styles broad, curved through 90 degrees and expanded distally, apical margin with a short excavation bounded by two eminences; on inner face of each style a tapering short curved process directed posteriorly.

HOLOTYPE: Described from one male taken at Barro Colorado, Canal Zone, by H. F. Schwarz on March 15, 1933.

The genus *Paracixius*, which has the tegmina very shallowly tactiform and the abdomen not laterally compressed, is probably most nearly related to *Cixius* Latreille but differs considerably in the shape of the vertex, the lateral extension of the margins of the frons, in details of the tegminal venation, especially in having the union of the claval veins much more basad, in the absence of setae on the tegminal veins, and in the wing venation, most notably in the first branch of the cubitus.

Dictyopharidae

PROTACHILUS, NEW GENUS

Vertex twice as broad as long, anterior margin convex in an obtuse angle, extending to level of anterior margin of eyes, posterior margin angularly excavate, subparallel to anterior, lateral margins carinate, slightly diverging posteriorly, median carina present only in basal half, a short crescentic carina on each side in anterior half of vertex subparallel to anterior margin, disc of vertex sunken, lowest point at middle; base of frons broadly visible from above; frons longer than broad (1.6 to 1), basal margin truncate, lateral margins diverging gradually, almost straight to below level of antennae and then slightly incurved to suture, median carina distinct, more feeble at base; clypeus slightly tumid, medially and laterally carinate; frons and clypeus in profile shallowly convex; median ocellus absent; labium with apical joint less than half length of penultimate; antennae with first segment very short, second segment subglobose, studded with distinct round pits, indented apically at point of insertion of third segment; antennal flagellum apparently rather short, situated terminally at middle of distal surface of third segment; head with eyes not quite so broad as pronotum. Pronotum in middle about as long as vertex in middle or very slightly longer, anterior margin convex between eyes, posterior margin angularly excavate, turning cephalad laterally; disc flattened, or very slightly convex, median carina distinct, lateral carinae of disc absent, a weak carina at each margin between eye and tegula, lateral fields of pronotum below eyes a little longer than broad; mesonotum broader than long, disc elongate oval, almost flat, tricarinate, lateral carinae convex, slightly curving inwards at base, scutellum short, subrectangularly pointed at tip. Protibiae 1.5 times as long as pro-femora, post-tibiae armed with four spines before apex, the first spine small and near base; a row of seven spines at apex; second joint of hind tarsus subequal to third joint in ventral view, distal margin concave, a spine at each angle, distal margin of first and second joints bordered with an even row of minute teeth (approximately 20 and 14, respectively), with a distal fringe of short setae each almost as stout as one of the teeth.

Tegmina approximately four times as long as wide, widest across membrane, apical margin evenly rounded; Sc+R forking before stigma at a distance equal to its length, M forking about halfway between level of Sc+R fork and base of stigma. Cu_1 forking near middle of tegmen, R with four apical cells, M with six, Cu_1 with two; a complete line of transverse veins subparallel to apical margin; first vein of clavus joining second at about middle, a transverse vein between Cu_2 and first claval vein; the common claval stalk entering commissural margin before apex of clavus; apex of clavus closed, approximately three-quarters from base of tegmen; no cross veins on corium apart from R-M and M-Cu, nor on membrane apart from subapical line. Tegmina devoid of granulation and setae. Wings with Sc simple, R forked twice before apex, M with anterior branch forked near margin, posterior branch simple, Cu_{1a} forked twice, Cu_{1b} simple.

Anal segment of female long, fully three times as long as wide, apical margin medially excavate, telson not projecting beyond margin, anal foramen comparatively small. Third valvulae not quite so broad as long, rounded distally, apical portion abruptly membranous with distal margin rounded; first valvulae moderately long, straight on dorsal margin, shallowly convex on ventral margin, tapering distally with a row of seven teeth on dorsal margin; a semimembranous lobe of equal size attached ventrally at base; second valvulae as long as first, slender, tapering distally.

GENOTYPE: *P. rex*, new species.

Protachilus rex, new species

Figures 9–21

FEMALE: Length, 7.5 mm.; tegmen, 10.5 mm.

Vertex, frons, clypeus, and lorae fuscous-piceous finely speckled with pallid yellow, lateral margins of vertex at base yellow, genae yellow with a fuscous-piceous oblique band before eye, a second above and a third beneath antenna; pronotum speckled fuscous and dull yellow in equal amounts; mesonotum with lateral fields piceous, an oblique pallid line anteriorly meeting lateral carinae of disc, an approximately Y-shaped pallid mark at lateral angles, a pale spot halfway along posterior margin, disc fuscous with minute pale spots, a short oblique pallid line near base of each lateral carina directed anteromedially, tip of scutellum pallid; sternum fuscous and pale in subequal patches; pro- and meso-femora and tibiae fuscous speckled pallid, with three paler bands, post-femora testaceous with two fuscous bands, post-tibiae testaceous, fuscous speckled with testaceous in grooves.

Tegmina hyaline, a brown spot across M in corium at middle, a series of short brown bars between claval veins, a brown suffusion with a tendency to barring on posterior half of membrane, a few scattered infuscate spots distad of subapical line, stigma fuscous with its venules paler; veins alternately piceous and pallid ivory, transverse veins of nodal line fuscous, of subapical line transparent, pale. Wings hyaline, veins fuscous.

First valvulae of ovipositor with seven teeth, the basal tooth simple, twisted, the second, third, and fourth bicuspidate with the accessory cusp much less sclerotized than the primary, the fifth tooth very short and broad across the base, the sixth and seventh moderately long and curved; second valvulae slender, rod-like, parallel, equal in length to first, ornamented with a membranous convex lobe on dorsal margin near apex.

HOLOTYPE: Described from one female collected at Sant' Anna do Chapada, near Cuyabá, Brazil, very probably by H. H. Smith, as it was donated to the Museum by his wife in 1922. A second female specimen was later seen at the United States National Museum.

The affinities of this genus are puzzling. It appears to be closest to *Cladodiptera* Spinola, though it differs very markedly in head structure and in tegminal venation. The head is slightly reminiscent of *Taosa* Distant, while the speckled coloration is reproduced in a much slighter degree in such genera as the African *Paranagnia* Melichar. The ovipositor and anal seg-

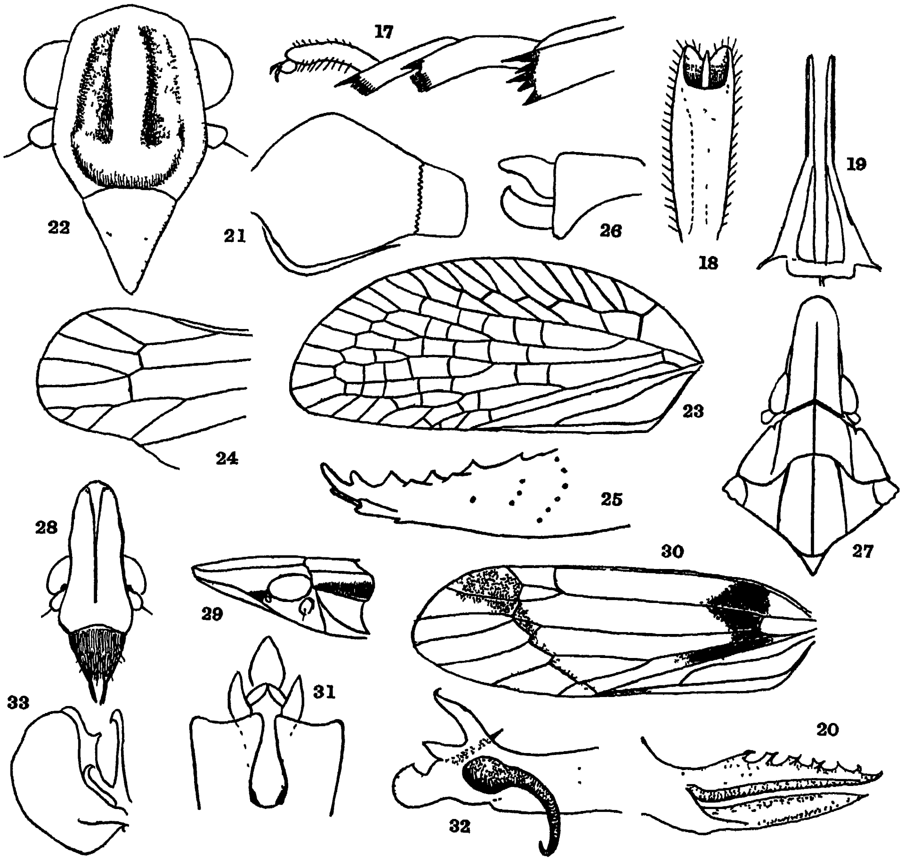


Fig. 17. *Protachilus rex*, new species, hind tarsus, lateral view.
Fig. 18. Idem, anal segment, dorsal view.
Fig. 19. Idem, second valvulae of ovipositor, ventral view.
Fig. 20. Idem, first valvula of ovipositor, left side, lateral view.
Fig. 21. Idem, third valvula of ovipositor, lateral view.
Fig. 22. *Alcestis quadrata*, new species, head, frontal view.
Fig. 23. Idem, left tegmen.
Fig. 24. Idem, apical portion of wing.
Fig. 25 Idem, first valvula of ovipositor, right side, lateral view.
Fig. 26. Idem, anal segment of female, lateral view.
Fig. 27. *Biruga chapadae*, new species, head and thorax, dorsal view.
Fig. 28. Idem, head, frontal view.
Fig. 29. Idem, head and pronotum in profile.
Fig. 30. Idem, left tegmen.
Fig. 31. Idem, pygofer and anal segment of male, dorsal view.
Fig. 32. Idem, aedeagus, right side, lateral view.
Fig. 33. Idem, right genital style, lateral view.

ment conform to the general type found among species of *Taosa*. In the second specimen examined there are traces of lateral carinae on the frons basally.

Tropiduchidae

ALCESTIS STÅL

Alcestis STÅL, 1862, K. Svenska Vetensk.-Akad. Handl., vol. 3 (for 1859–1860), art. 6, p. 11.

GENOTYPE: *A. pallescens* Stål, *loc. cit.*

Alcestis quadrata, new species

Figures 22–26

FEMALE: Length, 5.0 mm.; tegmen, 7.2 mm.

Frons longer than broad (1.2 to 1), median carina broad, anchor-shaped, posttibiae with three spines. Tegmina with Sc enclosing 12 cells at margin and with a row of five submarginal cells; basal costal cell four-sided, the distal sides short and meeting in an obtuse angle.

Stramineous; tegmina and wings hyaline. In life, insect probably pallid green with veins green.

Anal segment of female very short, apically truncate; telson two-thirds as long as segment. Ovipositor with third valvulae fairly broad, ventral margin convex, dorsal margin straight with a finger-shaped setigerous lobe lying along it to near apex, apex with seven short curved teeth, four on margin, three subdorsal, somewhat basad; first valvulae long, tapering distally, slightly curved, each with a thin semi-membranous lobe of same shape lying against its inner face; dorsal margin with six large teeth and two very small intercalary teeth, ventral margin with one bicuspidate tooth and one simple tooth directed horizontally at apex; a single minute eminence laterally at middle, with a curved row of three basad of it and a second row of six still further basad; second valvulae semi-membranous, thin, short, tapering evenly and rather abruptly distally.

HOLOTYPE: Described from one female taken at Sant' Anna do Chapada, Brazil, probably by H. H. Smith.

This species is near *solitaria* Melichar but differs in the shape of the basal costal cell and in size.

BIRUGA, NEW GENUS

Vertex about three times as long as eyes, longer in middle than broad across base (1.7 to 1), anterior margin strongly curved, lateral margins straight, finely carinate, diverging slightly towards base, posterior margin angularly excavate, disc depressed, median carina narrow, very distinct, not reaching apical margin; frons nearly twice as long as broad, lateral margins expanding from base to above level of eyes, then very slightly tapering and further distad diverging to below level of antennae and bending abruptly inward to suture, carinate, median carina stout at base, narrowing distally, absent on apical fifth; clypeus devoid of median and lateral carinae. Pronotum in middle two-thirds length of vertex, median and lateral carinae distinct, fine, a strong thin carina between eye and tegula, pronotal surface between carinae depressed; mesonotum much broader than long, disc subquadrate, tricarinate, lateral carinae slightly convex, diverging to base. Hind tibiae with a minute spine near base and two spines in apical third.

Tegmina nearly three times as long as broad, asymmetrically rounded at apex, Sc+R forked at level of stigma, M forked immediately before nodal line of cross veins, Cu_1 forked three-eighths from base, claval veins uniting slightly basad of level of Cu_1 fork, three subapical cells (Sc, M, Cu_1), seven apical excluding stigmal cell. Wings with R and M simple to apical margin.

Pygofer very deeply cleft dorsally.

GENOTYPE: *B. chapadae*, new species.

Biruga chapadae, new species

Figures 27–33

MALE: Length, 3.2 mm.; tegmen, 3.0 mm.

Testaceous, probably greenish in life; a horizontal band before eye, median carina of pronotum, and a band on pronotum behind each eye tinged red; clypeus, sternum, and sclerites of abdomen fuscous.

Tegmina hyaline, costal cell opaque

pallid yellow, a broad fuscous band across basal fifth; apical cells of Sc and a very narrow band along and inside transverse cross veins to apex of clavus paler fuscous; veins testaceous. Wings hyaline with testaceous veins.

Pygofer deeply cleft dorsally. Anal segment arising at base of cleft, fairly long, with lateral margins setigerous, expanding distally, telson approximately ovate in dorsal view, projecting about two-thirds beyond apex of segment. Aedeagus moderately short, laterally compressed, dorsal margin shallowly concave, ventral margin slightly convex, unequally trilobed in a vertical plane at apex, roughly E-shaped, the dorsal lobe sinuately tapering, with a recurved hook at tip, the middle lobe shortest, abruptly tapering, the ventral lobe longest, rounded, assuming a subfalcate form by reason of a membranous lobe dorsally; a very stout ventrally incurved process on right side near apex and a narrow, straight spine directed obliquely dorsad and cephalad at almost same level on left side, the former process with its basal portion swollen.

HOLOTYPE: Described from one male taken at Sant' Anna do Chapada, Brazil, probably by H. H. Smith.

This genus is apparently nearest to *Athestia* Melichar but differs markedly in its general shape and tegminal venation. It is interesting to note the appearance in this species of the same basic color pattern of the tegmina as is found in *Achilorma bicincta* Spinola.

Lophopidae

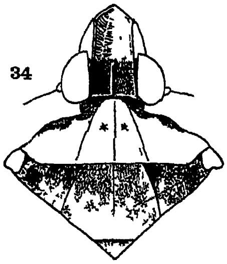
UCAYALIA, NEW GENUS

Vertex longer than broad (1.9 to 1), anterior margin angularly convex, lateral margins straight, slightly diverging basally, posterior margin transverse, disc deeply sunken, median carina distinct in basal two-fifths, absent distally; frons in middle longer than wide at widest part below antennae (1.3 to 1), base slightly more than half as wide as apex, concave, lateral margins slightly concave, diverging to below level of antennae, thence incurved to suture, median and lateral carinae distinct, not quite reaching to apex, the surface between the lateral carinae slightly elevated; clypeus about half as long as frons, lateral margins carinate in basal half, median carina distinct; genae broad, ocelli absent; frons and clypeus in profile straight, suture impressed, clypeus rectangular distally. Head with eyes a little more than half as wide as pronotum. Pronotum two-thirds as long as vertex in middle, anterior margin bluntly pointed on disc, sinuately convex laterad, posterior margins straight, curved cephalad near sides, disc of pronotum elevated, tricarinate, lateral carinae straight, diverging basally, an impressed spot on each side near middle of disc; mesonotum twice as broad as long, disc at base broader than long, almost flattened except anteriorly, tricarinate, lateral carinae strongly diverging basad, apex of scutellum marked off by a transverse constriction. Pro- and meso-femora and tibiae flattened and much expanded, pro-femora with sides straight, diverging distally, apically truncate; tibiae almost straight on inner margin, convex on outer; post-tibiae not expanded, with three spines before apex.

Tegmina very shallowly tectiform, broad, costal and commissural margins almost parallel, apical margin bluntly convex, apical and sutural angles subequally rounded; precostal area short, beginning at basal fifth of margin and ending just before level of apex of clavus; Sc+R forking near base, M and Cu_1 forking at approximately same level near middle of tegmen, longitudinal venules of membrane numerous, cross veins irregular, apical line of cross veins regular, nodal line very irregular or indistinct, two irregular series of cross veins between apical and nodal series.

Pregenital segment with a rounded eminence medially. Ovipositor with third valvulae fully two and one-half times as long as broad, obliquely falcate distally, rounded basally, beset with stout setae, dorsal margin not sclerotized. Anal segment of female placoid, with a short basal stalk, anal foramen situated at distal end of stalk, telson short, broad, distal plate like part of segment deflexed, vertical. Waxy secretion on anal segment dull white.

GENOTYPE: *U. nigrovittata*, new species.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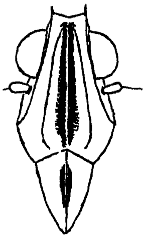
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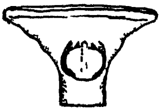
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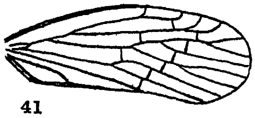
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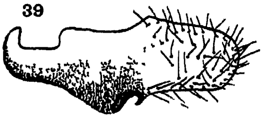
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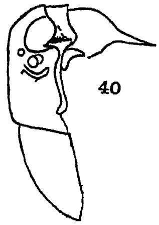
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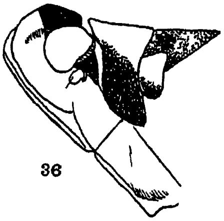
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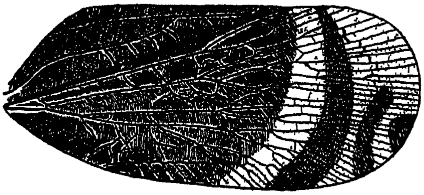
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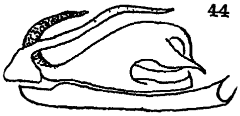
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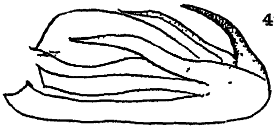
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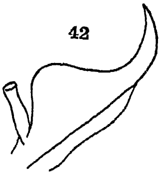
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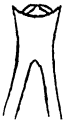
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Fig. 34. *Ucayalia nigrovittata*, new species, head and thorax, dorsal view.
Fig. 35. Idem, head, frontal view.
Fig. 36. Idem, head in profile.
Fig. 37. Idem, left tegmen.
Fig. 38. Idem, anal segment of female, dorsal view.
Fig. 39. Idem, third valvula of ovipositor, lateral view.
Fig. 40. *Cedusa irengana*, new species, head and pronotum in profile.
Fig. 41. Idem, right tegmen.
Fig. 42. Idem, left genital style.
Fig. 43. Idem, aedeagus, left side.
Fig. 44. Idem, aedeagus, right side.
Fig. 45. Idem, anal segment of male, dorsal view.

Ucayalia nigrovittata, new species

Figures 34–39

FEMALE: Length, 8.5 mm.; tegmen, 9.1 mm.

Head and pronotum dull yellow; a broad band overlying median carina of frons, a narrower band along median carina of clypeus, posterior half of vertex, sides of head above eyes, lateral fields of pronotum and ventral half of tegulae, fore and middle legs piceous; mesonotum dully infuscate with two darker suffusions outside disc on each side anteriorly; hind legs and abdomen fuscous.

Tegmina yellowish brown, semitransparent in membrane, piceous brown on corium and reddish brown in three very sharply defined bands on membrane, the first broad, arcuate subparallel to apical margin, passing from nodal area to near apex of clavus, the second somewhat narrower, arising on apical margin and terminating near middle of membrane, the third ovate, lying on apical margin anterior of middle. Wings uniformly paler reddish brown.

HOLOTYPE: Described from one female taken on the middle Río Ucayali, Peru, by H. Bassler, on March 25, 1929.

Derbidae

CEDUSA FOWLER

Cedusa FOWLER, 1904, Biologia Centrali-Americana, Insecta, Rhynchota, Hemiptera-Homoptera, vol. 1, p. 112.

GENOTYPE: *C. funesta* Fowler, *loc. cit.*; Muir, 1913, Bull. Exp. Sta. Hawaiian Sugar Planters' Assoc., Ent. Ser., no. 12, p. 35.

Cedusa irengana, new species

Figures 40–45

MALE: Length, 1.9 mm.; tegmen, 2.9 mm.

Fuscous; rostrum, except distal segment, and legs with tarsi testaceous; apical segment of rostrum piceous; membrane of abdomen red.

Tegmina and wings pale smoky, both powdered pale gray, veins fuscous.

Anal segment of male tubular with sides concave, anal foramen near apex. Aedeagus straight, tubular, with a reflexed flagellum at apex; two recurved spinose processes dorsally on right at apex, one relatively stout and evenly curved obliquely cephalad, the other distinctly longer, sinuate, almost horizontal in apical quarter; on left side at apex a broad sinuate tapering lobe directed cephalad, more nearly inclined to horizontal than preceding; flagellum in form of a sclerotized hood-like lobe with a subsidiary tapering process near apex on right side, and a short point at tip, the whole underlain by a sclerotized band forming a loop in a horizontal plane. Genital styles with ventral margin slightly convex, dorsal margin strongly convex with a rather long narrow stylar process near base and a very stout incurved spine at apex.

HOLOTYPE: Described from one male labeled "Ireng R. to Roraima, Brazil, Aug. 17, 1911."

This species differs in coloration from *venosa* Fowler and *funesta* Fowler.

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MARINE TURBELLARIA FROM THE ATLANTIC COAST OF NORTH AMERICA

BY LIBBIE H. HYMAN

Accumulated material of marine flatworms from our Atlantic coast, chiefly the coast of Maine and Newfoundland, has furnished the occasion for this paper. The larger marine Turbellaria of our Atlantic coast are probably now fairly well known, but very much remains to be done on the small and minute forms.

ORDER ACOELA

FAMILY PROPORIDAE

AFRONTA, NEW GENUS

DEFINITION: Proporidae without frontal pore or cluster of frontal glands and without accessory female parts; mouth behind middle, pharynx short; single genital pore, male, at rear end; penis simple, without papilla.

TYPE: *Afronta aurantiaca.*

Afronta aurantiaca, new species

Figures 1–3

MATERIAL: One specimen, sectioned.

FORM: Cylindroid, rounded at both ends, 2 mm. long (fig. 1).

COLOR: Orange yellow, whitish at ends, dorsal surface with short elongated clumps of brownish granules.

EYES: Lacking.

GENERAL STRUCTURE: Although the fixation (hot Flemming's strong solution) is excellent, the plane of the sections is unfortunate, being obliquely horizontal, slanting from left to right so that on any section, right-hand structures are more dorsal than left-hand ones. Further, a piece has been sliced off the posterior dorsal region, apparently in trimming the block. These circumstances have detracted from a proper study of the specimen.

Epidermis completely ciliated (cilia did not preserve), apparently cellular, although cell walls are distinguishable with difficulty from the striated appearance common to acoel epidermis. As is usual among the Acoela, the epidermis is divided by an apparently fibrous membrane into a narrow border containing the basal bodies of the cilia and a broader inner stratum containing the nuclei (fig. 2). Rhabdites seen in living worm, but not apparent on sections. Epidermis contains clear spaces, somewhat more numerous anteriorly, continuity of these spaces with clear channels in mesenchyme plainly seen (fig. 2). These channels seem to lead to the mesenchymal vacuoles. No epidermal gland cells found. No cluster of frontal glands or frontal pore present. Whether isolated frontal glands exist or not could not be determined with certainty. A few bluish masses (haematoxylin stain) occur behind the brain that might be frontal glands, but they did not show any definite structure and could not be traced to the anterior end. Epidermis lacks basement membrane; is bounded from mesenchyme by definite muscle layer of outer circular and inner longitudinal fibers (figs. 2 and 3).

Mesenchyme has usual appearance—a granular vacuolated syncytium (fig. 3); large spaces occur around penis, smaller but still conspicuous ones in the peripheral mesenchyme, and quite small spaces in the central mesenchyme. Numerous nuclei in the peripheral, few in the central, mesenchyme. Parenchymal muscle fibers present, forming a lattice of longitudinal and transverse fibers (fig. 3).

Brain well developed (fig. 3), more or less quadripartite, sending two main bundles and some smaller ones forward, and two main bundles together with many other fibers backward. Statocyst present in posterior dorsal part of brain, fusiform, divided into three compartments, of which central one contains the statolith (fig. 3).

Mouth well behind middle (fig. 3), leads into short pharynx that is simply inturned epidermis, not differentiated in any way.

REPRODUCTIVE SYSTEM: Simple; gonads consist of paired strands of gametogonia, testes lateral and dorsal to ovaries. No accessory female parts found. Indefinite sperm ducts lead to cap-like seminal vesicle closely applied over anterior surface of penis (fig. 3). Penis consists of rounded mass at posterior end of worm; non-muscular but contains many nuclei. Long narrow lumen opens internally into seminal vesicle, externally by male gonopore at posterior end of worm (fig. 3); lumen lined by hardened material; no penis papilla seen. Sperm appear to be of short thick shape.

LOCALITY: Mt. Desert Island, Maine, dredged in surface mud at a depth of 30 feet, near the Mt. Desert Island Biological Laboratory, August 16, 1937.

TYPE: One set of serial sections (one slide) deposited in A.M.N.H., Cat. No. 339.

REMARKS: This is the specimen mentioned in my 1938 report as a species of *Plagiostomum*. Sections showed the animal to be an acoel, not an alloeocoel. A new genus appeared to be necessitated by the lack of frontal glands, lack of differentiated pharynx, and simple tubular penis without papilla.

ECTOCOTYLIDAE, NEW FAMILY

DEFINITION: Acoela of ectocommensal habits, with tubular plicate pharynx, and caudal adhesive disk.

ECTOCOTYLA, NEW GENUS

DEFINITION: Ectocotylidae with armed penis, seminal bursa with one nozzle, and two genital pores.

TYPE: *Ectocotyla paguri*.

Ectocotyla paguri, new species

Figures 4–8

MATERIAL: Number of specimens sent by Dr. E. G. Reinhard.

FORM: Fusiform, curved, middle part plump, ends narrowed, posterior end terminates in adhesive disk, less than 1 mm. long (figs. 4–7).

COLOR: White; interior yellow during sexual maturity.

EYES: Lacking.

GENERAL STRUCTURE: Four specimens were sectioned, and although the sections are fairly good, some details could not be determined. Body is completely ciliated according to Dr. Reinhard's observations on living specimens; cilia were lacking on preserved animals. Body lacks typical epidermis; is clothed with a narrow, apparently structureless membrane (fig. 8) of firm, elastic nature, thrown into folds wherever contraction occurs. Presumably epidermis is, therefore, of the "insunk" type, common among Acoela, in which the nuclei are sunk into the mesenchyme. No trace of frontal glands. Anterior tip contains elongated eosinophilous structures, probably rhammites (fig. 8); no rhabdites found. Rear end forms circular adhesive disk covered with adhesive papillae (fig. 8), to which could be traced eosinophilous strands in underlying mesenchyme, presumably outlets of eosinophilous gland cells, but not clearly distinct from muscle fibers, also eosinophilous. Epidermal membrane has sharp inner boundary, just inside which is subepidermal musculature, chiefly of longitudinal fibers; circular fibers were not definitely seen. Longitudinal muscle layer gradually increases in thickness towards posterior end and is well developed in connection with adhesive disk.

Mesenchyme consists of loose granular material, containing scattered nuclei, more abundant ventrally. No mesenchymal muscle fibers seen.

Well-developed brain present just anterior to pharynx; consists of oval mass, granular in center, encircled by nerve cells (fig. 8); no definite nerve strands seen. Statocyst embedded in anterior surface of brain.

PHARYNX: Is unique among the Acoela in being of the plicate, protrusible type, similar to that of planarians. When protruded was seen to be covered with cilia and to be armed with a few spines (fig. 4), according to observations of Dr. Reinhard on living specimens; spines were not seen in sections. Pharynx lies in pharyngeal cavity opening by mouth anterior to middle of body (fig. 8), shortly behind brain. Pharyngeal cavity and outer and inner surfaces of pharynx lined by same structureless membrane as general body surface. Under epidermis, thin layer of longitudinal muscle fibers; interior of pharynx consists of mesenchyme with nuclei, concentrated near the surfaces; along center of mesenchyme eosinophilous strands occur, probably pharyngeal glands, seeming to open at distal end of pharynx. Pharynx leads directly into mesenchyme.

REPRODUCTIVE SYSTEM: What were presumed to be testes consist of several compact groups of spermatogonia in lateroventral regions (fig. 8). No ovaries or ovogonia were found but all specimens contain in ventral part of plump central body region, round deeply staining masses, each lodged in a mesenchymal compartment bounded by fibers. These masses appear to be syncytia, composed of areas with small nuclei and other areas of larger nuclei. It is presumed that these masses are embryos and hence that the animal is viviparous. Separate male and female gonopores present. Male gonopore in front of stalk-like posterior end; leads into tubular cavity whose inner end contains the penis. Penis consists of oval thick-walled sac armed with curved, hook-like stylet. No seminal vesicle or channels leading to the penis were found but behind the penis is some eosinophilous material, probably glands associated with the male system. Female gonopore shortly anterior to male gonopore (fig. 8). Leads into rounded cavity with muscular wall in which is lodged the seminal bursa, a rounded mass with muscular wall, provided with one nozzle (mouthpiece). Exact relation of bursa to its cavity could not be determined—bursa probably attached to wall of cavity by the nozzle.

HABITS: Ectocommensal on the surface of the hermit crab, *Pagurus pubescens*. Active, lively, moving rapidly about in measuring-worm fashion (fig. 7), alternately attaching anterior end and adhesive disk.

LOCALITY: Biological station of the University of Maine, Ellsworth, Maine, epizoic on *Pagurus pubescens*, collected August, 1940, by Dr. E. G. Reinhard.

COTYPES: Several specimens mounted whole (one slide) and set of sections (one slide), A.M.N.H., Cat. Nos. 340, 341.

REMARKS: This animal is remarkable in several ways: in the possession of a plicate pharynx, hitherto unknown among the Acoela, in the presence of a caudal adhesive disk, also not previously found in the order, and in its ectocommensal habits. This appears to be the first ectocommensal acoel found, although several entocommensals are known, inhabiting the interior of echinoderms.

ORDER ALLOEOCOELA

FAMILY **PLAGIOSTOMIDAE**

Plagiostomum album Hyman, 1938

Figures 9–11

MATERIAL: Several specimens collected in tidal zone on shores of Mt. Desert Island, Maine.

FORM: Plump, cylindroid, to 4 mm. long (fig. 9), anterior end slightly narrowed, blunt, posterior end forming a little tail or at times or in larger specimens rounded or indented.

COLOR: White with a black spot between, and in front of, the eyes and a delicate lacing of brown lines over the dorsal surface.

EYES: Four, in a trapezoid arrangement (fig. 9).

GENERAL STRUCTURE: My own serial sections have been supplemented by others kindly lent by Dr. Ulric Dahlgren. Body clothed in a ciliated epidermis, of low columnar form, taller at the two ends, especially the posterior end, than elsewhere. Whether the epidermis is cellular or not could not be determined. It contained no special structures. Definite basement membrane present underlain by usual subepidermal muscle layer of outer circular and inner longitudinal fibers; diagonal fibers appeared to be absent. Muscle layer gradually increases in thickness towards posterior end. No frontal pore or cluster of frontal glands present; some large cyanophilous gland cells occur in the sides of the anterior end. Mesenchyme compact; parenchymal muscle fibers are present in fair numbers. The material was not favorable for a detailed study of the nervous or excretory systems. No indications of the latter system were found.

Digestive System: Subterminal mouth opens into wide pharyngeal cavity, containing free distal end of very large pharynx, which in life equals about one-fourth the body in length. Pharynx of variabilis textus type, in which outer muscular wall consists of outer circular and inner longitudinal fibers, while inner muscle layer next the lumen is reversed with outer longitudinal and inner circular fibers (fig. 10). Strong radial fibers course between inner and outer walls of pharynx. Powerful sphincter muscle occurs near distal end of pharynx. Well-developed nervous stratum is situated to inner side of outer muscle layers, but no definite nerve ring noticed. Pharynx leads by brief narrowed esophagus into sacciform intestine, which has peculiarity of extending forward around proximal end of pharynx (fig. 9). Intestine consists of thick, highly vacuolated, apparently syncytial epithelium underlain by a delicate layer of circular muscle fibers.

Reproductive System: Testes are a pair of elongated masses in lateral body regions to either side of the rear part of the pharynx and anterior part of the intestine. Ovaries are a pair of rounded bodies posterior to the testes. No ducts were found leading from the gonads to the copulatory apparatus, except that the distal end of the common ovovitelline duct was seen entering the roof of the male antrum in the sagittal series of sections (fig. 10). Sagittal section of copulatory apparatus shown in figure 10; frontal view of apparatus from more mature specimen cut horizontally, from sections lent by Dr. Dahlgren, shown in figure 11. In the latter series the common ovovitelline duct could not be found. This duct constitutes the entire female part of the apparatus. Male apparatus complicated, beginning with elongated seminal vesicle placed longitudinally and ventrally. Posterior end of this curves and enters pyriform prostatic vesicle, directed forward; this has lumen in less mature specimen (fig. 10), but is filled with prisms of secretion in mature specimen (fig. 11). Prostatic vesicle is covered with thick layer of prostatic glands. Distal end of prostatic vesicle narrows, curves posteriorly, enters proximal end of long canal-like penis bulb containing the introverted penis papilla. Wall of penis bulb consists of epithelium underlain by muscle layer of inner circular and outer longitudinal fibers. Penis papilla very long and slender composed of two epithelia with strong longitudinal muscle fibers between. Mass of unicellular glands embraces base of penis papilla and enters with longitudinal muscle fibers. Base of penis papilla continuous with conical protuberance, usually termed penis sheath, that projects posteriorly into proximal end of genital antrum. Penis sheath has construction similar to wall of penis bulb and of antrum and receives some unicellular glands. Genital antrum consists of widened anterior part that bears penis sheath at its proximal end and receives oviduct into dorsal wall; and of narrowed distal part that leads to common genital pore at rear end of body. This narrowed part receives on each side bundle of long-necked unicellular glands, and from its proximal end there projects ventrally a rounded, thick-walled blind sac of unknown purpose. This sac seems to contain in its anterior wall some glandular masses, but this could not be determined precisely. Wall of antrum consists of epithelium, then circular, then longitudinal muscle fibers; its narrowed distal part and also the lining of the blind sac are ciliated.

Differential Diagnosis: *P. album* differs from other members of the genus in the combination of long pharynx, forward projection of intestine around inner end of pharynx, very elongated form of penis bulb, penis papilla, and common antrum, and blind ventral sac of antrum. *P. album* considerably resembles both in external characters and details of the copulatory apparatus the common European freshwater *P. lemani.*

Locality: Mt. Desert Island, Maine, under stones in the tidal zone.

Type: One set of sagittal serial sections (one slide) deposited in A.M.N.H., Cat. No. 338.

ORDER TRICLADIDA

SUBORDER MARICOLA

FAMILY **PROCERODIDAE**

Subfamily **Procerodinae**

GENUS **PROCERODES** GIRARD, 1850

Procerodes littoralis (Ström), 1768

Syn.: *Hirudo littoralis* Ström, 1768.
Planaria littoralis O. F. Müller, 1776.
Planaria ulvae Oersted, 1843.
Procerodes Wheatlandii Girard, 1850.
Planaria frequens Leidy, 1855.
Procerodes ulvae Verrill, 1893.

A number of specimens which I assign to this species were presented to me by Dr. A. S. Pearse who collected them at Brigus, Newfoundland, August 16, 1938. There is scarcely any species of turbellarian regarding which there has been more taxonomic confusion than this one. Wilhelmi (1909) in his monograph failed to clear up the confusion, and it has remained for Bock (1926) to settle the matter finally. Further synonymy will be found in these two references, together with a discussion of the taxonomic history of the form. I accept the conclusion of Bock that *Planaria littoralis* and *Procerodes ulvae* are identical, and that the valid name is *Procerodes littoralis* (Ström). This species then evidently occurs along the northern shore of the North Atlantic from Newfoundland to Scandinavia. It remains for me to consider whether *Procerodes Wheatlandii* is conspecific with *Procerodes littoralis* (= *ulvae*). Wilhelmi (1907, 1909) maintains that they are not but gives no grounds for this opinion except that he has studied material from their respective localities. Comparison of his figures of the entire animal (1909, pl. 1, figs. 17 and 19) and of the sagittal section of the copulatory apparatus (1909, pl. 15, fig. 13, and pl. 16, fig. 9) clearly shows that there is no difference between his *P. ulvae* and *P. Wheatlandii* except the larger size of the copulatory bursa in the former. I, too, have studied alive and as whole mounts and serial sections specimens of *Procerodes Wheatlandii* from the Massachusetts coast, and I have compared them with the Newfoundland specimens that I consider to be *P. littoralis* (= *ulvae*). I am not able to see any difference between these forms, except that the Massachusetts specimens are smaller than the Newfoundland ones and that they have a smaller copulatory bursa. These are not adequate grounds for a specific distinction. I am, therefore, of the opinion that the Massachusetts form called since Wilhelmi's monograph *Procerodes Wheatlandii* is conspecific with the European *P. littoralis* (= *ulvae*) or at best is but a geographic race or variety of the latter. The smaller size of the Massachusetts specimens may be merely of ecological nature, an illustration of the general rule that animals increase in size towards the poles.

Procerodes Warrenii (Girard), 1850

Syn.: *Vortex Warrenii* Girard, 1850.
Fovia Warrenii Girard, 1852.

A yellowish gray marine triclad with truncate anterior end devoid of auricles is common along the shores of Mt. Desert Island, Maine, under rocks in the tide zone. It appears probable to me that this is *Procerodes Warrenii*, although certain identification was impossible as no sexual specimens were found. This species appears to be seldom taken in the sexual state. What is known about it is given in Wilhelmi's monograph (1909).

GENUS **FOVIELLA** BOCK, 1925

Foviella affinis (Oersted), 1843

Syn.: *Planaria affinis* Oersted, 1843.
Fovia affinis Stimpson, 1857.
Fovia affinis Jensen, 1878.
Planaria littoralis Van Beneden, 1860.
Fovia affinis Jensen, 1878.

A number of specimens which I assign to this species were collected by Dr. A. S. Pearse at Brigus, Newfoundland, August 16, 1938, and turned over to me. The taxonomic history of this species is also very complicated and has been reviewed by Bock, 1925, who has given a good description of the species for which he created the name *Foviella*. I found no differences between my specimens and Bock's description. This species, like *Procerodes littoralis,* therefore, ranges along the North Atlantic coast from Scandinavia to Newfoundland.

PROBURSIDAE, NEW FAMILY

DEFINITION: Maricola with copulatory bursa anterior to the penis bulb and with posterior ovaries, situated at the level of the posterior end of the pharynx.

PROBURSA, NEW GENUS

DEFINITION: With the characters of the family.

TYPE: *Probursa veneris.*

Probursa veneris, new species

Figures 12, 13

MATERIAL: Several whole mounts and sets of serial sections presented by Dr. Marvin Meyer.

FORM: Preserved specimens of elongated oval shape (fig. 12), presumably more elongated and slender in life, to 3 mm. long; auricles not evident on whole mounts but stated by Dr. Meyer to be present.

COLOR: Brownish black, flecked and streaked.

EYES: Usual two, somewhat back from anterior end as usual in Maricola.

GENERAL STRUCTURE: A few points may be mentioned. Digestive tract sends median branch forward in front of eyes (fig. 12); posterior rami of digestive tract are confluent at posterior end. Ventral nerve cords have strong cross connection below the penis bulb; they are also confluent at the posterior end.

REPRODUCTIVE SYSTEM: Large testes, about seven to nine on each side, occur as usual between bases of digestive branches (fig. 12); they fill space from ventral nerve cords to dorsal epidermis. First pair is close behind eyes; last pair about level of copulatory bursa (fig. 12). Sperm ducts form spermiducal vesicles ventral to copulatory bursa, unite to common sperm duct that enters middle of penis bulb. Ovaries are a pair of rounded bodies to either side at level of posterior end of pharyngeal chamber. Oviduct leaves postero-lateral surface of each ovary, proceeds posteriorly lateral to ventral nerve cord, at level of genital antrum curves inward and dorsally and, accompanied by eosinophilous glands, enters the bursal canal on that side about where bursal canal joins genital antrum. Large copulatory bursa of irregular rounded form lies anterior to penis bulb as in fresh-water triclads; bursal canal leaves center of posterior surface of bursa; is very narrow at first, proceeds posteriorly above penis and, widening gradually, curves ventrally, receiving the two oviducts separately on each side, and enters common antrum. Penis consists of large, very muscular bulb placed immediately behind copulatory bursa and elongated penis papilla. Bulbar lumen is lined by wavy glandular epithelium. Common gonopore occurs below penis papilla. Glands open on ventral surface behind gonopore. Sagittal view of copulatory complex shown in figure 13.

LOCALITY: Fire Island, which is a sand bar on the Atlantic Ocean side of Long Island, New York, near the western end of the latter. Habitually found in empty shells of the clam *Venus*, whence the specific name. Collected September 4, 1940, by Dr. Marvin Meyer.

TYPE: One whole mount, deposited in A.M.N.H., Cat. No. 328; cotype, one set of serial sections (four slides), A.M.N.H., Cat. Nos. 329–332.

REMARKS: This triclad has two remarkable features in which it differs from all known Maricola: the posterior position of the ovaries and the location of the copulatory bursa anterior to the penis bulb. Although some Maricola are known in which the copulatory bursa curves forward so as to lie above the penis papilla, none is known in which the bursa is situated anterior to the penis bulb except the present species. This location of the bursa is identical with the location characteristic of fresh-water triclads. Throughout the triclads the ovaries are situated anteriorly, shortly behind the eyes, and although they may be somewhat more posterior than this in some Maricola, in no other known triclad do they occur so far posteriorly as in *Probursa veneris.*

ORDER POLYCLADIDA

SUBORDER ACOTYLEA

SECTION CRASPEDOMMATA

FAMILY CRYPTOCELIDAE

COMPROSTATUM, NEW GENUS

DEFINITION: Cryptocelidae with tentacular and cerebral eye clusters, anteriorly located pharynx, interpolated prostatic vesicle, and large Lang's vesicle.

TYPE: *Comprostatum insularis.*

Comprostatum insularis, new species

Figures 14–16

MATERIAL: Several preserved and live specimens sent by Dr. H. Humm.

FORM: Slender, elongate, sides parallel, both ends rounded (fig. 14), to 40 mm. long in life, about six times as long as wide.

COLOR: White with pink tinge, may have pink spots; pink color probably result of ingested food.

EYES: Marginal band of very small eyes, fades out posteriorly, so that posterior end lacks marginal eyes (fig. 14). Tentacular eye clusters occur behind level of the brain, consist of four or five to about eight eyes, depending on size of specimen. Brain has exceedingly large "granule masses." Cerebral eyes consist of elongated group on each side, beginning behind the brain and extending forward above brain and granule masses as a few widely spaced eyes to a level less than halfway the distance to the anterior margin (fig. 15). There are no frontal eyes as in other cryptocelids.

DIGESTIVE SYSTEM: Short, ruffled, rounded, or oval pharynx occurs well anterior to the middle. From it main intestine extends forward to brain giving off numerous lateral branches (fig. 14). In some specimens, main intestine also extends short distance behind pharynx; in other specimens this was lacking.

COPULATORY APPARATUS: Male apparatus, directed backward, lies about middle of body, some little distance behind the pharynx (fig. 14). Female apparatus behind male apparatus; separate gonopores. Sperm ducts become visible alongside pharynx; proceed posteriorly, widening into irregular, very thin-walled spermiducal vesicles, packed with sperm. These turn anteriorly about level of middle of prostatic vesicle and, running ventral to this vesicle, enter separately the posterior angles of the seminal vesicle. Latter is muscular, thick-walled, arched body, curving dorsally, then bending posteriorly, and by narrowed connection entering anterior end of large, elongated prostatic vesicle. Prostatic vesicle has thick muscular wall, is lined by tall, wavy, glandular epithelium, from which come blobs of secretion filling the lumen. Posterior end of prostatic vesicle narrows, passes directly into large, elongated penis papilla, which may be bent forward in some specimens. Penis papilla has muscular outer and inner walls of outer longitudinal and inner circular muscle fibers. Penis papilla lies in male antrum, opening below by male gonopore by way of narrowed channel.

Female gonopore, well separated from male gonopore, leads into forward-slanting passage having strong sphincter muscle (fig. 16). This opens proximally into expanded thin-walled vagina which makes an S-curve posteriorly and dorsally, becoming very thick walled with less wide lumen. Vagina then curves posteriorly, and after receiving in its ventral wall the common oviduct it narrows to form the stalk of Lang's vesicle. This stalk after a short posterior course enters the very large and elongated Lang's vesicle. The vagina appears to be ciliated throughout.

LOCALITY: Key Largo, Florida, under rocks in shallow water, fairly common, probably generally distributed throughout the Florida keys, collected in 1940 by Mr. Harold Humm; live specimens were sent in two shipments in January, 1944.

TYPE: One whole mount, A.M.N.H., Cat. No. 333; sexual region of the same removed and sectioned, four slides, A.M. N.H., Cat. Nos. 334–337.

SECTION SCHEMATOMMATA

FAMILY HOPLOPLANIDAE

Hoploplana inquilina (Wheeler), 1894

In my article on the Atlantic coast polyclads of the United States, 1940, I left open the question whether this species occurs, as claimed by Pearse, 1938, in two forms, the larger nominal form found on the Massachusetts coast commensal with the snail *Busycon*, and a smaller form, *thaisana*, found southward, commensal in the snail *Thais*. Additional information on this question has been furnished by Dr. Leslie Stauber, 1941, and Dr. Victor Schechter, 1943, both of whom have kindly sent specimens. Stauber reports the finding of considerable numbers of *H. inquilina* in the snail *Urosalpinx cinerea* Say in Delaware Bay. They were not found in *Busycon* in this locality. The largest of Stauber's specimens measure 5 by 3 mm., and most range from 1–3 mm. Hence, Stauber's data confirm the claim of Pearse that a smaller form of this species exists along the more southern part of our Atlantic coast. Schechter found *H. inquilina* in the snail *Thais floridana haysae* Clench in Barataria Bay, Louisiana. These specimens are much larger than any previous specimens recorded, measuring up to 8 by 5 mm. The variety of *Thais* is also larger than *Thais floridana floridana* in which Pearse found his specimens of *Hoploplana "thaisana."* The present indications, therefore, are that there is but one form of *Hoploplana inquilina* upon our coast and that its size varies with the size of the host and probably other environmental circumstances.

SUMMARY

1. Two new acoels, one new alloecoel, one new marine triclad, and one new polyclad are described from the Atlantic coast of North America.

2. The acoels are *Afronta aurantiaca*, family Proporidae, and *Ectocotyla paguri*, new family Ectocotylidae, both from the Mt. Desert Island region, Maine. The former lacks frontal glands and accessory female structures. The latter is one of the most remarkable acoels yet discovered, having a protrusible plicate pharynx and caudal adhesive disk provided with adhesive papillae; it also appears to be viviparous. It is epizoic on the hermit crab *Pagurus pubescens*.

3. *Plagiostomum album*, also from the Mt. Desert Island region, is described.

4. The marine triclads *Procerodes littoralis* (Ström), 1768 (=*Procerodes ulvae*), and *Foviella affinis* (Oersted), 1925, are reported from Brigus, Newfoundland; hence these species are distributed in the North Atlantic from Newfoundland to Scandinavia. *Procerodes Wheatlandii* Girard, 1850, found on the Massachusetts coast, is considered to be at best a geographic variant of *P. littoralis*.

5. A new marine triclad, *Probursa veneris*, new family Probursidae, shores of Long Island, New York, differs from all known triclads in the far posterior position of the ovaries and differs from all other marine triclads in having the copulatory bursa situated anterior to the penis bulb.

6. A new polyclad, *Comprostatum insularis*, family Cryptocelidae, is described from the Florida keys.

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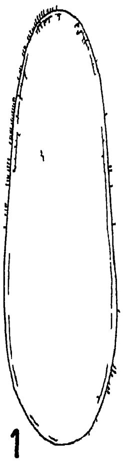
FOR ALL FIGURES

1, epidermis; 2, brain; 3, statocyst; 4, testes; 5, ovaries; 6, mouth; 7, seminal vesicle; 8, penis; 9, male gonopore; 10, basal bodies of cilia; 11, epidermal nucleus; 12, mesenchymal nuclei; 13, channels; 14, adhesive disk; 15, rhammites; 16, pharynx; 17, pharyngeal cavity; 18, embryos; 19, seminal bursa; 20, female gonopore; 21, penis stylet; 22, adhesive papillae; 23, eyes; 24, intestine; 25, sphincter; 26, prostatic vesicle; 27, penis bulb; 28, penis sheath; 29, ovovitelline duct; 30, male antrum; 31, common gonopore; 32, prostatic glands; 33, penis glands; 34, blind sac; 35, common antrum; 36, copulatory bursa; 37, bursal canal; 38, common sperm duct; 39, bulbar lumen; 40 cerebral eyes; 41, tentacular eyes; 42, marginal eyes; 43, main intestine; 44, sperm ducts; 45, Lang's vesicle; 46, penis papilla; 47, vagina; 48, common oviduct; 49 stalk of Lang's vesicle; 50, penis papilla; 51, granule mass.



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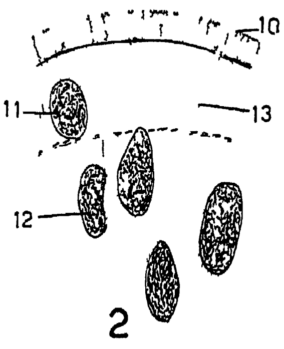

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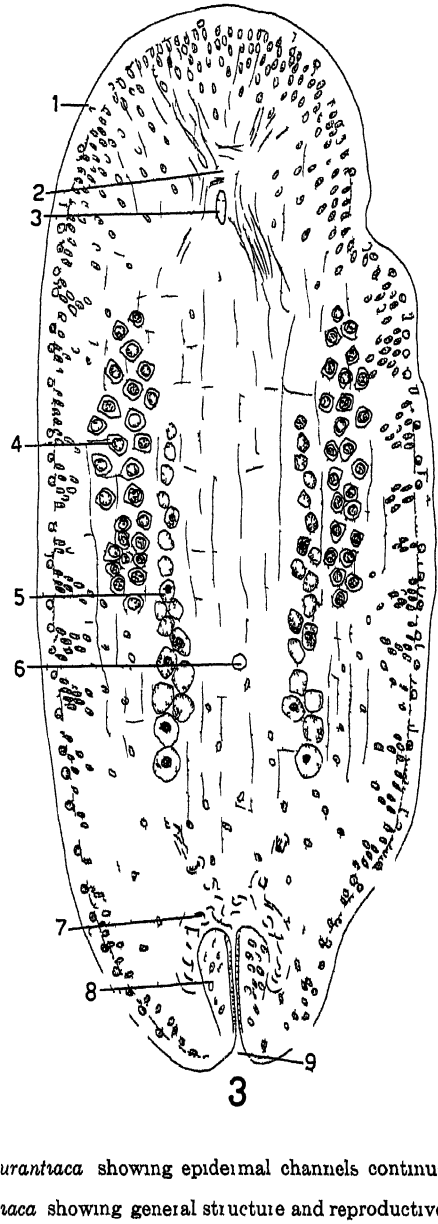

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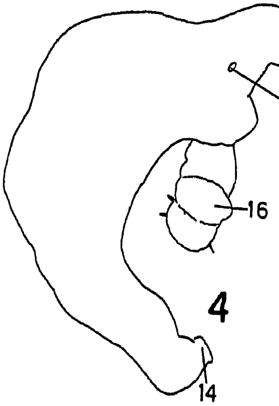
Fig 1 *Afronta aurantiaca* from life
Fig 2 Anterior epidermis of *Afronta aurantiaca* showing epidermal channels continuous with mesenchymal spaces
Fig 3 Frontal section of *Afronta aurantiaca* showing general structure and reproductive system



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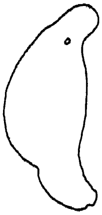

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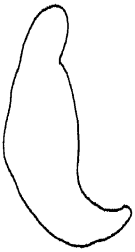

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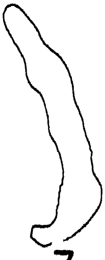

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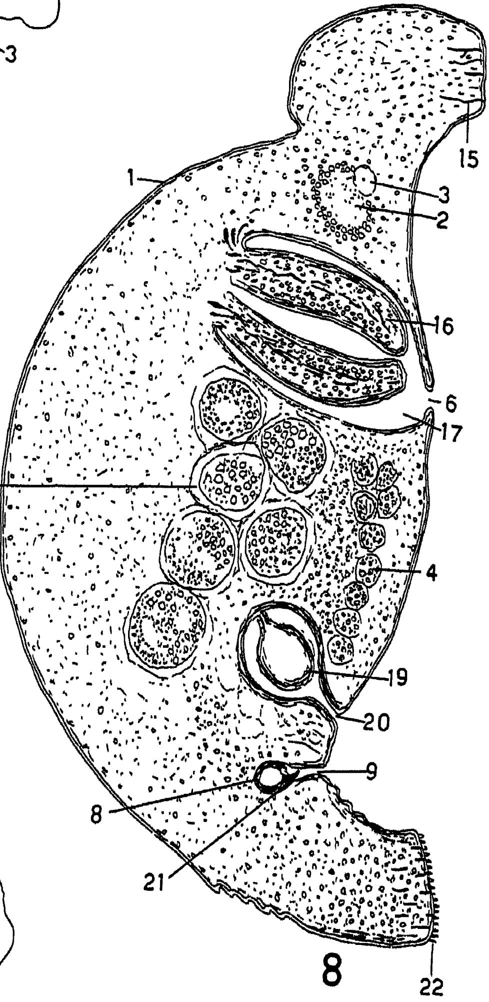

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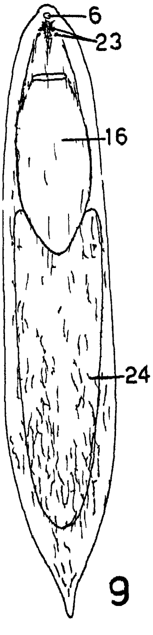
Fig. 4. Side view of *Ectocotyla paguri*, showing general shape and extended pharynx, sketched from life by Dr. E. Reinhard.

Figs. 5–7. Sketches of living specimens of *Ectocotyla paguri* made by Dr. Reinhard: 5, dorsal view; 6, lateral view; 7, worm in act of crawling.

Fig. 8. Sagittal section of *Ectocotyla paguri*, showing general structure, plicate pharynx, reproductive system, and embryos.



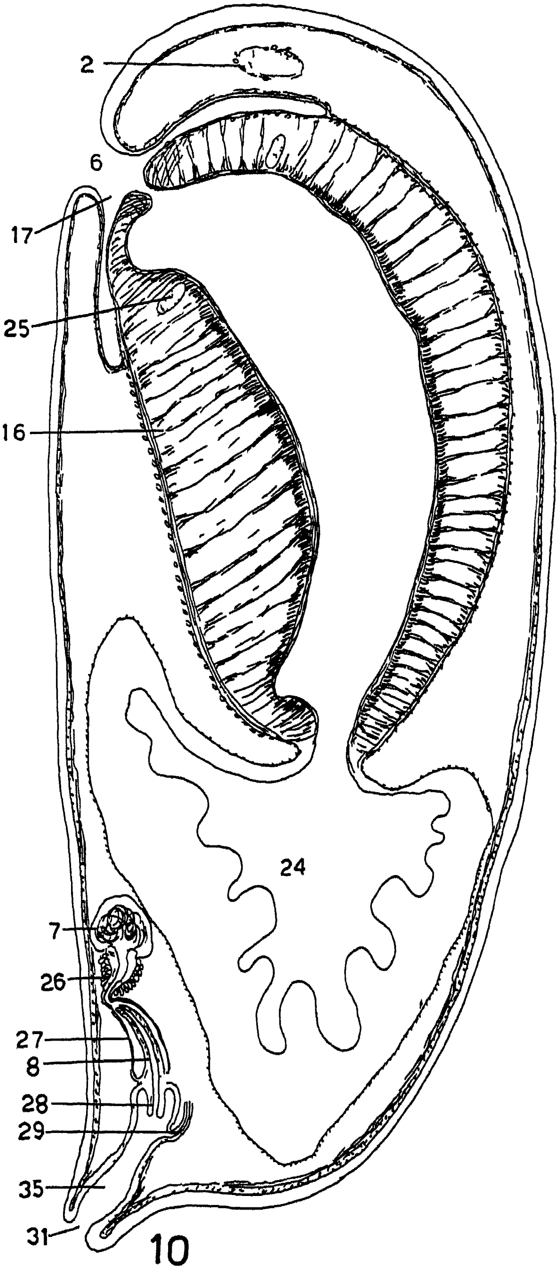
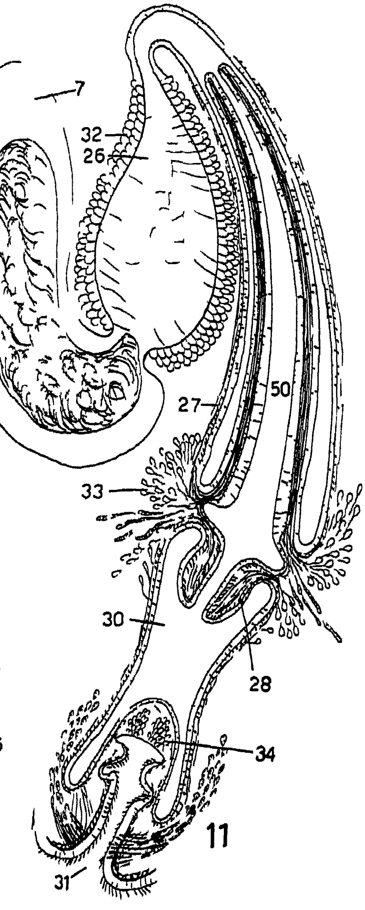


Fig 9 *Plagiostomum album* from life
Fig 10. Sagittal section of *Plagiostomum album*, showing general structure



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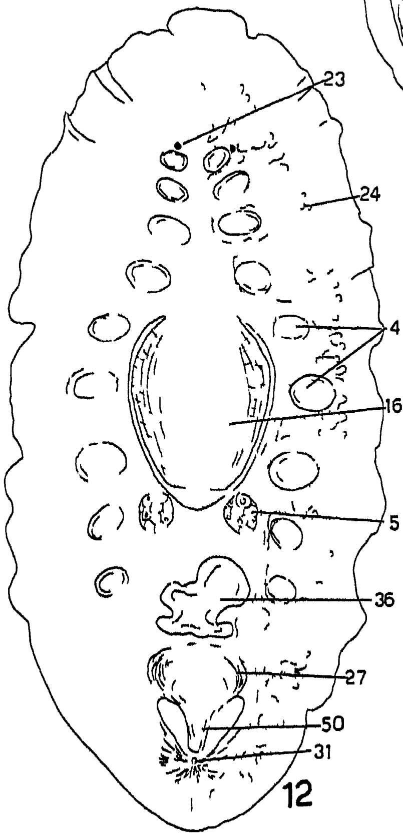

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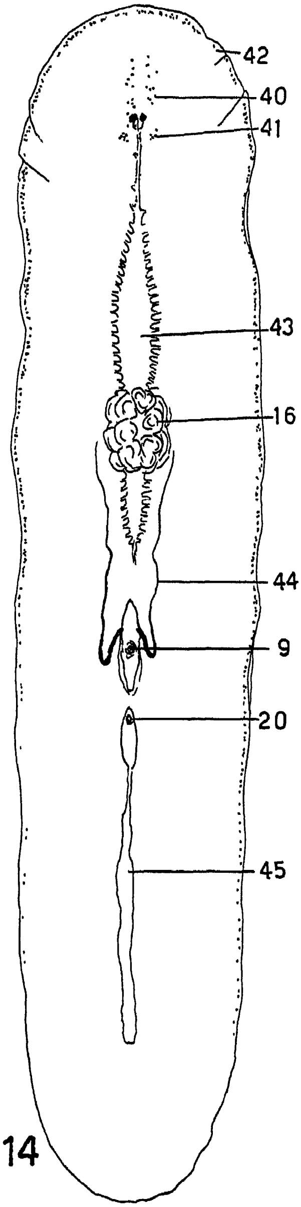
Fig 11 Frontal view of copulatory apparatus of *Plagiostomum album*, from sections courtesy of Dr Ulric Dahlgren

Fig 12 *Probursa veneris* from whole mount courtesy of Dr Marvin Meyer, showing general structure



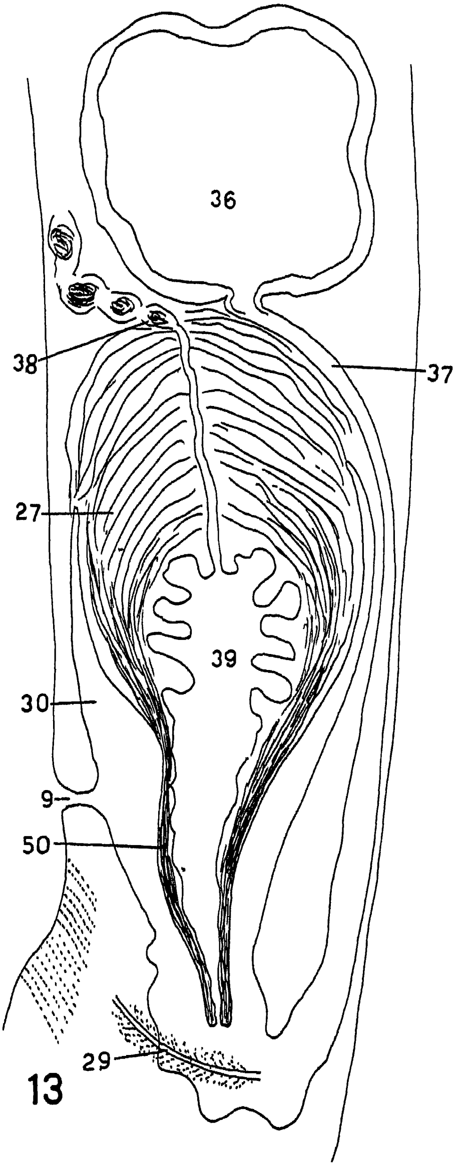
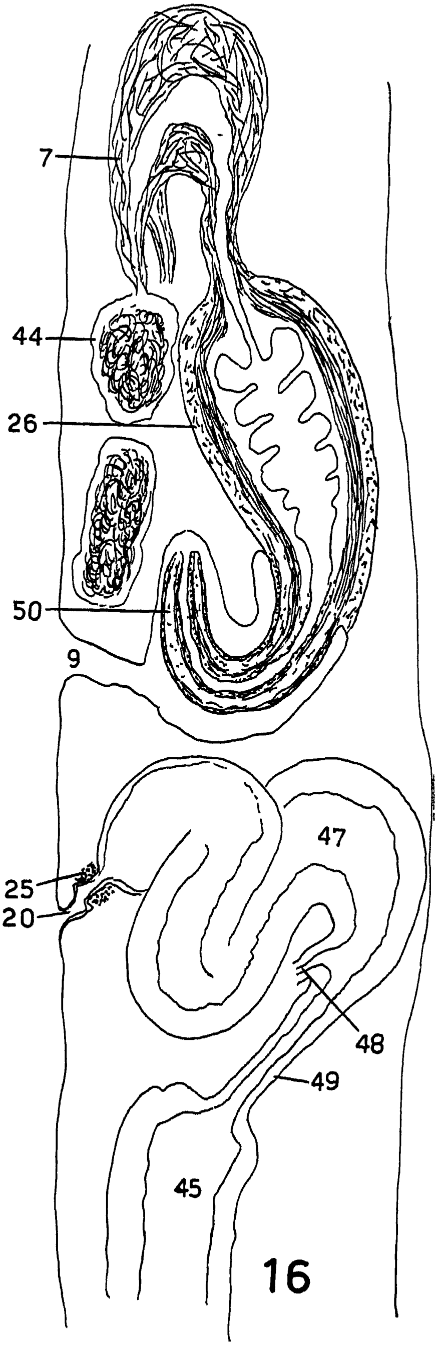


Fig. 13. Sagittal view of the copulatory apparatus of *Probursa veneris*.
Fig. 14. *Comprostatum insularis*, from whole mount.



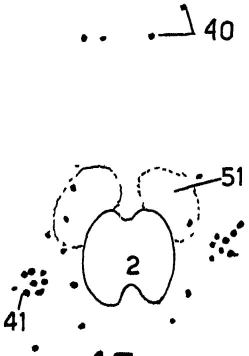


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Fig. 15. Eye arrangement of *Comprostatum insularis.*
Fig. 16. Sagittal view of the copulatory apparatus of *Comprostatum veneris.*

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A NEW *CRYPTOTIS* FROM COSTA RICA

BY GEORGE G. GOODWIN

General comparison of Museum material in connection with work in progress has revealed the existence of a hitherto unrecognized species of short-tailed shrew from Volcan Irazu in the United States National Museum collection. For the privilege of describing this species I am indebted to Dr. Remington Kellogg. I am indebted for the loan of material to the United States National Museum, Chicago Natural History Museum, Museum of Comparative Zoölogy, and the Museum of Zoology, University of Michigan.

Cryptotis jacksoni, new species

JACKSON SHORT-TAILED SHREW

TYPE: U.S.N.M. (Biol. Survey Collection) No. 116649, female adult, collected at Volcan Irazu by M. Cary, February 27, 1902. The type is a skin and skull in good condition and the only known specimen.

GENERAL CHARACTERS: A medium-sized, uniformly colored, dusky shrew, similar in general appearance to *C. gracilis* from Talmanca, Costa Rica, but somewhat browner, with shorter pelage, and a noticeably broader skull.

DESCRIPTION: Entire animal dark mummy brown, color of underparts barely differentiated from back, the fur dark smoke gray heavily overlain with mummy brown, tail about the color of the back, scales on feet dusky but space between annulations white. Skull slender, the superior outline depressed behind the orbits, posterior border of anteorbital foramina over space between m^1 and m^2; braincase broad, the lateral angles well indicated when viewed from above. Dentition: upper unicuspid teeth not crowded, inner tubercles moderately developed, the first three with a well-developed heel which, when viewed from the side, rises almost to the line of the pigmentation on the main cusp: second unicuspid slightly larger than the first, third unicuspid smaller than first, fourth very small but in line with the toothrow; the large upper premolar sharply reduced anteriorly, its posterior border about equal in length to the outer border; m^3 relatively large with distinct metacone and third commissure. Mandible with no special peculiarities of form.

MEASUREMENTS: Total length, 110 mm.; tail vertebrae, 34.5; hind foot, 14.5 (dry, 13.5); skull: condylobasal length, 19.4; zygomatic breadth, 6; distance between zygomatic root and gnathion, 8.2· breadth of braincase, 10; breadth across m^2–m^2, 5.5; length of mandible, 11; length of mandible, entire, 12.9; maxillary toothrow, entire, 9; mandible toothrow, entire, 8.2.

REMARKS: With the exception of the type of *C. gracilis*, I have seen all the Costa Rican specimens of *Cryptotis* in American collections, a total of 17 specimens. Four species can now be recognized:

C. nigrescens from San Isidro, a small black shrew with small feet and a large head. The skull of *nigrescens* is as large as either that of *gracilis* or *jacksoni*, but the dentition is decidedly heavier and more crowded; the upper unicuspid teeth, viewed laterally, are simple without any indication of a posterior heel, and the small fourth unicuspid is crowded inward from the toothrow, the large upper premolar is exceptionally broad; m^3 is reduced, with mesostyle, metacone, and their third commissures barely indicated.

C. orophila from the Irazu Range is a small species, similar to *C. micrura* from Guatemala but smaller with underparts paler in color than back. The skull is about one-third smaller than that of *nigrescens*, with crowded dentition of a similar general pattern but much smaller, weaker, and breadth of the large upper premolar noticeably less.

C. gracilis is nearer in cranial characters to *jacksoni* than either *nigrescens* or *orophila*, but the width of the skull throughout is considerably less than in the new species. This peculiarity is equally appreciable in the braincase, interorbital region, rostrum, and palate. The upper cheek teeth of *gracilis* also share in the general reduction of the width of entire skull, especially noticeable in the large premolar, the posterior border of which is decidedly shorter than the outer, while in *jacksoni* they are about equal.

A large female from Las Vueltas, 8000 feet elevation, in the University of Michigan collection, needs comparison with the type of *C. gracilis*. It apparently has a similar elongated skull, narrow rostrum and palate, small braincase, and the large upper premolar is noticeably longer than broad. It is, however, considerably larger than the type in both external and cranial measurements and appears to carry the elongation of the skull to the extreme.

Miller, when he described *gracilis*, used the type of *C. jacksoni* for comparison, assuming it to be a topotype of *C. orophila*. The label on the type of the latter, which is a poor specimen with a fragmentary skull, reads Irazu Range instead of Volcan Irazu as given in Allen's description. Material now available indicates that the type of *orophila* probably came from nearer the foothills than the upper slopes of Volcan Irazu and is an entirely different species.

The shrew *Cryptotis jacksoni* is named in recognition of Hartley H. T. Jackson's valuable work on the American shrews.

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NOTE ON THE FIRST EOCENE MAMMAL FROM SOUTH CHINA[1]

BY CHUNG-CHIEN YOUNG[2]

During the late spring of 1938, a left lower jaw with m_3 was collected by Messrs. M. N. Bien, Y. Y. Lee, and the present writer, from the "Red Beds" extensively developed in the Hengyang Basin. This specimen was unearthed at a spot about 200 meters from the small town named Changpiliang, about 15 kilometers northeast of Hengyang (Young and Bien, 1939; Young, Bien, and Lee, 1938). It represents, so far, the only determinable mammalian fossil from this basin. In the northern part of Hengyang, apparently from the same formation, very fragmentary specimens of turtles and crocodiles have been found but are not yet described. The discovery of the lower jaw of an early mammal thus gives the only proof that the "Red Beds" in Hunan, the age of which has been debated among geologists without decision, really belong to the Eocene. It is, therefore, of interest to have the specimen adequately described.[3] The present note is based upon a line drawing by the artist of the National Geological Survey of China and brought by me to the American Museum of Natural History in New York for comparison. It is my pleasure to express my cordial thanks to members of the staff of this Museum for all the courtesy during my stay there.

DESCRIPTION

FAMILY **PALAEOHIPPIDAE**

Subfamily **Hyracotherinae**

GENUS **PROPALAEOTHERIUM** GERVAIS

Propalaeotherium hengyangensis, new species

MATERIAL: Cenozoic Research Laboratory No. V-214. A left lower jaw with m_3.

HORIZON AND LOCALITY: Middle Eocene from the "Red Beds" of the Hengyang Basin at Changpiliang, about 15 kilometers northeast of Hengyang, Hunan Province, China. Collected by C. C. Young, M. N. Bien, and Y. Y. Lee, 1938.

DIAGNOSIS: A small Hyracotherinae somewhat smaller than *Propalaeotherium sinensis*. The outline of the crown of m_3 tapers considerably backwards. The posterior arm of the first lobe (metaconid) is distinctly subdivided. The inner margin of the three lobes is low and deeply open and marked by a series of small "wrinkles." Cingulum well developed only on the anterior and the external sides.

DESCRIPTION: The lower jaw has the anterior part in front of the third molar and the posterior part of the ascendens process broken off. Both the ascending ramus and the angular process start to expand immediately behind the posterior margin of m_3 in a noticeable way. The third molar is composed of three lobes abruptly decreasing in size backwards. This backwards tapering of the tooth is remarkably similar to that of *Propalaeotherium argentonicum*. The tooth shows no trace of wear and be-

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[1] Published by permission of the Director of the National Geological Survey of China.

[2] Palaeontologist, National Geological Survey of China; Member, Technical Committee, National Resources Commission of China.

[3] When the specimen was first discovered in the field, no reference or comparative material was available, due to war conditions. Because of the subdivision of the metaconid of this lower molar 3, I compared it by memory with the problematic specimen *Adapidium yuanchuensis*, from Yuanchü, and later mentioned this possible comparison in the two papers referred to above. Subsequent studies, however, have proved the Hunan specimen so brachyodont that the possibility of relationship to *Adapidium* is out of the question.

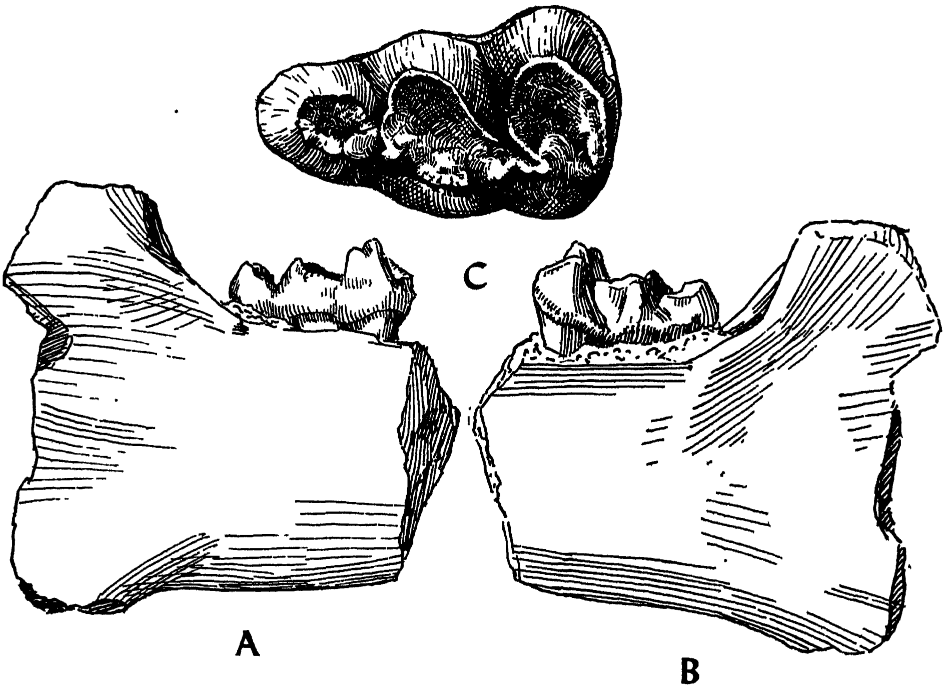

Fig. 1. *Propalaeotherium hengyangensis*, new species. Cenozoic Research Laboratory No. V-214. Left lower jaw, inner view (A), and outer view (B). Twice natural size. Lower molar 3, crown view (C). Five times natural size.

longs certainly to a young individual. In external view, the tooth is moderately brachyodont, being marked by a distinct cingulum which extends also anteriorly, while in inner view the tooth is less in height and there is no trace of cingulum. In the crown view, the three lobes form three basins, respectively, with the inner side low and partly open. The external side of the anterior two lobes is curved in such a gentle manner that it forms no sharp, recognizable angle, as in other species of the genus. The inner side of the posterior arm of the first lobe, which represents the highest part of the tooth (metaconid), is distinctly subdivided. Along the margin posterior to that point the tooth is marked by a number of small, fine wrinkles. The second lobe is lower than the posterior part of the first lobe and is again sharply separated by the third lobe which forms a nearly closed basin.

MEASUREMENTS

Height of the jaw behind the tooth (external)	19.0 mm.
External length of m_3 at the base	12.0 mm.
Median length of m_3 above the crown	8.0 mm.
Median length of m_3 at the base	10.0 mm.
Anterior maximum breadth of m_3 at the base	5.8 mm.

COMPARISONS AND DETERMINATION: The general structure of the tooth fits well with that of *Palaeotherium sinensis* described by Zdansky from Kuanchuang, Mengyin Hsien, in Shantung Province (Zdansky, 1930). But our form is a little smaller (length and breadth of m_3 of *P. sinensis* 13-13.3; 6.2-6.6, respectively). In addition, the second lobe of *P. sinensis* is about the same size as the first one, and in that of the present form it is distinctly smaller. This is chiefly responsible for a difference in outline between both forms. Furthermore the present specimen is characterized by the subdivision of the metaconid, by the narrower opening of the lobes on the inner side, and by the presence of small wrinkles along the inner margin. The latter character may be due simply to the less worn state of the tooth.

In view of the differences mentioned above, I prefer to erect a new species for the Hunan specimen, for which the name *Propalaeotherium hengyangensis*, new species, is proposed. It may be noted that the species name is purposely dedicated not only to the locality where the specimen was found but also in memory of the severe battleground Hengyang has become against the invaders in 1944.

The genus *Propalaeotherium* is known only from the middle Eocene in Europe, and *P. sinensis* is regarded by Zdansky as also belonging to the same age. The present form thus gives a clue for dating the "Red Beds" in Hunan.

P. hengyangensis is derived from a rather lower level of the Red Beds. It is highly probable that the Hengyang Red Beds were deposited since the Eocene, immediately after the Early Tertiary disturbance. How late the Red Beds extend into younger geological time, there is no definite proof, but probably their deposition was stopped by the Hengyang movement. The dating of the Red Beds near Changpiliang, therefore, does not necessarily mean that the whole formation is middle Eocene in age. The present form, so far, represents the first determinable mammalian fossil from South China.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. 54

NOTES ON SOME GENERA FROM THE SOUTHWEST PACIFIC

BY ERNST MAYR

During an examination of the birds of the southwest Pacific, which was made in the course of the preparation of a handbook on the birds of that area, I came across some genera, mostly monotypic, the validity of which seemed doubtful to me. I undertook, therefore, a thorough revision of the taxonomic characters of these genera and found that 13 of them are not sufficiently distinct to deserve recognition: *Coryphoenas*, *Urodynamis*, *Microdynamis*, *Pyrrhoglaux*, *Mochthopoeus*, *Cryptigata*, *Malacolestes*, *Myiolestes*, *Meliphacator*, *Amoromyza*, *Kubaryum*, *Megazosterops*, and *Rhamphozosterops*. The detailed evidence for this conclusion is presented on the following pages.

CORYPHOENAS RAMSAY

In the Ibis (1890, p. 246) R. G. Wardlaw Ramsay proposed the genus *Coryphoenas* for a Solomon Islands pigeon, previously known as *Turacoena crassirostris* Gould. Ramsay showed correctly that the species is not a *Turacoena* nor too close to *Macropygia*. This had already been demonstrated on anatomical grounds by Haswell (1883, Proc. Linn. Soc. New South Wales, vol. 7, p. 116). Ramsay, however, overlooked the fact that Salvadori had already removed *crassirostris* from *Turacoena* and placed it in *Reinwardtoena*, where it is indeed well placed. *R. crassirostris* agrees very well in general coloration, proportions, and shape of the bill with *R. browni*, differing only by having the bill slightly heavier. The habits of *R. crassirostris* are typically those of a *Reinwardtoena*. The species is obviously the Solomon Islands representative of the Bismarck Archipelago *R. browni*, and the slight differences are by no means sufficient to justify the recognition of the monotypic genus *Coryphoenas*, which must be considered a synonym of *Reinwardtoena*.

URODYNAMIS SALVADORI AND MICRODYNAMIS SALVADORI

Around 1876, eight species were included in *Eudynamis* (*parva*, *honorata* [=*scolopacea*], *mindanensis*, *orientalis*, *cyanocephala*, *rufiventer*, *melanorhyncha*, and *taitensis*). Salvadori realized that this was a somewhat heterogeneous assemblage and erected in 1878 the genus *Microdynamis* for *parva* and in 1880 the genus *Urodynamis* for *taitensis*. The changed species concept, which has been adopted by ornithologists during the past 40 years, finally led Hartert to combine all the remaining "species" of *Eudynamis* into a single one (*scolopacea*). Peters in his "Check-list of birds" (1940, vol. 4, p. 37–39) and other authors recognize 19 subspecies in this species. Thus, the genus of 1876 with eight species has been replaced by three monotypic genera. The question is pertinent whether or not the three species are really different enough to justify the recognition of three separate genera.

Urodynamis was separated by Salvadori from *Eudynamis* on the basis of its longer and more wedge-shaped tail, on its color pattern, and absence of sexual dimorphism. The only generic characters of *Microdynamis* mentioned by its describer are its "small size and remarkable plumage coloration." An inquiry into the validity of these so-called genera requires an analysis of their generic characters. In this connection it becomes at once obvious that *parva* is the most primitive or least-specialized species, *scolopacea* is intermediate, and *taitensis* is most specialized (except for coloration).

Size and Proportions: *E. parva* is the smallest species (wing, male, 103–110, female, 97–107), *taitensis* is larger (wing, male, 186–192, female, 175–185), *scolopacea* is largest and quite variable in its various races (wing, about 175–226). The true size is brought out even better by a comparison of the weights. They are as follows (in grams): *parva* 54 (male adult); *taitensis*, male, 118, female, 118, 122; *scolopacea alberti*, male, 143, female, 149, 177, 184. The large *scolopacea cyanocephala* is undoubtedly even heavier. However, *taitensis*, though smaller than *scolopacea*, has relatively longer wings and tail. The relative tail length of the three species is as follows: *parva*, male, 83.5–94.5 (89.3), female, 83.3–89.5 (85.5); *scolopacea* (variable), 88–102; *taitensis*, 120 per cent (of wing) or more. This elongation of the tail of *taitensis* is primarily one of the central tail feathers. The outermost tail feather is about 77 per cent of the wing length, exactly as in *scolopacea*. This unequal elongation is the cause of the strongly graduated tail of *taitensis*. In regard to the graduation of the tail, the three species form a series. In *parva* the outermost tail feather is 91–95 per cent of the length of the central tail feather, in *scolopacea* 74–83 per cent, and in *taitensis* 61–64 per cent. An exactly parallel lengthening of the distance between the longest and the shortest feather occurs in the wing. The tenth primary is 79–82 per cent of the length of the longest primary in *parva*, 69–77 per cent in *scolopacea*, and only 56 per cent in *taitensis*. In other words, the wing tip lengthens from about 20 per cent of the total wing length in *parva* to 44 per cent in the strongly migratory *taitensis*.

Color Pattern: Sexual dimorphism is absent in *taitensis*, but present in *parva* and *scolopacea*. The female of *parva* is very plainly colored, brownish gray with a faint indication of barring underneath. The male has a black cap with blue gloss, followed by two lines along the sides of the face, a whitish buff one and a blue-black line. The identical color pattern is found in females of *melanorhyncha* and other races of *scolopacea*. The adult male of *scolopacea* is always blue-black, but females are extremely variable; they are nearly always prominently spotted or barred. Very important is the fact that in most races some females are more hen feathered, others more masculine (Mayr, 1944, Bull. Amer. Mus. Nat. Hist., vol. 83, p. 150). This tendency has reached its culmination in *melanorhyncha*, where some of the females are all black with a blue-green gloss, almost exactly like the males, while other females are spotted and barred, like the typical females of the other races (Stresemann, 1940, Jour. Ornith., vol. 88, p. 455). Some females of this race are thus cock feathered. The opposite condition occurs in *taitensis* in which males are always hen feathered. This is not necessarily a primitive condition. In fact, all the evidence indicates that the loss of the typical male plumage of this species is a secondary development. It is observed in many island races or species, as in *Lalage sharpei*, *Pachycephala pectoralis*, *Petroica multicolor*, where it can be shown conclusively that the loss of the male nuptial plumage in certain island races is a secondary condition. On the other hand, the streaked pattern of *taitensis* is definitely an evolutionary novelty. It is not found in *E. parva* or in any of the races of *scolopacea*.

Conclusions: The above discussion gives the facts on which to base conclusions on the validity of the genera *Microdynamis* and *Urodynamis*. To begin with, there is no doubt that the three species *parva*, *scolopacea*, and *taitensis* differ from one another in size, proportions, and color pattern. The problem thus is reduced to the question as to whether or not these differences are sufficient to justify the recognition of three monotypic genera. Size cannot be considered a generic character, particularly in view of the strong geographic variation of size in the species *scolopacea*. The shape of the wing is almost identical in *parva* and *scolopacea*. It is $4 > 3 > 5 > 6 > 7 > 2 > 8 > 9 > 10 > 1$ in *parva* and may be the same in *scolopacea*. Other formulas in various races of *scolopacea* are: $4 > 3 = 5 > 6 > 7 > 2 > 8$ or $3 > 4 > 5 > 2 > 6 > 7 > 8$. In other words, the first primary is always shorter than any other, the second primary may be shorter or longer than the seventh and eighth, and either the third or the fourth primary is the longest feather of the wing. Even though the shape of the wing is nearly identical, *scolopacea* has a somewhat more pointed wing as shown by its longer wing tip (see above). In the migratory *taitensis*, the wing is even more pointed. Not only is the wing tip much longer, but also the wing formula is changed. The second primary is always longer than the seventh, and the first longer than the ninth and tenth. The wing formula is thus: $3 > 4 > 5 > 6 > 2 > 7 > 8 > 1 > 9 > 10$. A similar elongation of the wing has been described in other cases as a difference between migratory and sedentary races of a single species. Such a character surely cannot be raised to the rank of a valid generic criterion. The same is true for the striking difference in tail length. Huxley has shown (1932, "Problems of relative growth") that a small change in a growth factor can produce very striking differences in the ultimate form of an organ. The differences in shape of wing and tail among *parva*, *scolopacea*, and *taitensis* fit in excellently with other similar cases, illustrated by Huxley. The low taxonomic value of such changes of form become obvious where they occur in geographical races of the same species or in geographically representative species of the same superspecies. Stresemann (1925, Jour. Ornith., vol. 73, p. 152) has shown this for races of the starling *Lamprocolius chloropterus* and of the bird of paradise *Paradigalla carunculata*, and Stonor (1938, Proc. Zool. Soc. London, ser. B, vol. 108, p. 440) for *Astrapia* and other birds of paradise. (For a map of the representative *Astrapia* species, see Mayr, 1942, "Systematics and the origin of species," fig. 24, p. 230.)

It seems to me that the differences between *parva*, *scolopacea*, and *taitensis* are merely variations of the same basic features, such as have been found in other cases within geographically variable species. They are not fundamental enough to justify the recognition of three monotypic genera. This conclusion remains valid, even if it should become necessary to split *scolopacea* into several species in case some of its "races" have partly overlapping ranges.

PYRRHOGLAUX YAMASHINA

On the Palau Islands lives a small owl (*podarginus* Hartlaub and Finsch), which was originally described in the genus *Noctua*, but which has been considered a scops owl (genus *Otus*) by the majority of recent authors. In 1938 Yamashina established a new genus *Pyrrhoglaux* for this species (Tori, vol. 10, no. 46). In the diagnosis the following striking differences (compared with *Otus*) are listed: "Small owl without ear-tufts. Facial disks are very much reduced, only the feathers of lores disposing radially. Wings are much rounded, fifth and sixth primaries almost equal in length are the longest. Only ten rectrices [as against 12 in other owls] . . . Tarsi bare, excepting some feathers growing along the upper half of the front. Toes completely bare from either feathers or bristles."

This impressive list of generic differences convinced Peters of the validity of *Pyrrhoglaux*, and he accepted this genus in volume 4 of his "Check-list" (p. 109). However, the first time I handled specimens of this species I was struck by its resemblance to *Otus spilocephalus*. Should *podarginus* be merely an aberrant island representative of *spilocephalus?* This question can be answered only by a minute comparison of the two species. The feathers on the sides of the occiput do not form distinct ear tufts in *podarginus*, but in *spilocephalus* also these feathers are much less elongated, as compared to *Otus scops* or other *Otus*. The reduction of the length of the ears is apparently only part of the reduction of the feathering of the entire plumage. It is apparent in the facial disk, although a study of Mr. Coultas' well-made skins reveals that it is not so far reduced as stated by Yamashina. The toes of both *podarginus* and *spilocephalus* are unfeathered, and in *spilocephalus* the lowest third of the posterior part of the tarsus is also bare. This reduction of the feathering of the tarsus has progressed in *podarginus* in which the lower third of the tarsus is entirely bare, even in front. In this development *spilocephalus* (and *podarginus*) are an exact parallel to the tropical races of *Otus scops* in which also the lower third or quarter of the tarsus is bare (Delacour, 1941, Zoologica, New York, vol. 26, p. 138).

That the shape of the wing of scops owls is subject to strong geographical variation was also pointed out by Delacour (*loc. cit.*). In *spilocephalus* the wing tip is formed by primaries 4, 5, and 6, all three being subequal, with 5 being slightly longer, even in *podarginus*, not 6 as stated by Yamashina. Primaries 3 and 7 are next in length and about subequal. The greatest variation occurs in regard to primary 2, which may be longer than 8 in *latouchei*, is larger than 9 in *spilocephalus*, *alfredi*, and in some specimens of *podarginus*, and is shorter than 10 in some specimens of *podarginus* and in *luciae*. The Kina Balu race *spilocephalus luciae* has the most rounded wing, with a formula 5 = 6 > 7 > 4 > 8 = 3 > 9 > 10 > 2 > 1. There is more variability in *podarginus*. The wing may be as round as 5 = 4 = 6 > 7 > 3 > 8 > 9 > 10 > 2 > 1 or as pointed as 5 > 4 > 6 > 3 > 7 > 8 > 2 = 9 > 10 > 1. This corresponds almost entirely to the normal wing of *spilocephalus*, 5 > 4 > 6 > 3 > 7 > 8 > 2 > 9 > 10 > 1. Obviously, there is nothing in the wing formula of *podarginus* that would justify its generic or even specific separation from *spilocephalus*. The Kina Balu subspecies *luciae* has an even more rounded wing.

This leaves the number of tail feathers to be discussed. It is 12 in *spilocephalus*, *latouchei*, and *vulpes*. Of three specimens of *alfredi* one has 12 tail feathers, the other two only 10. All three specimens of *luciae* examined by me have only 10 tail feathers, so have all the specimens of *podarginus*.

This evidence can be summarized as follows: all the characters of *podarginus* on which its generic separation was based are subject to geographical variation in the genus *Otus* and in particular in *Otus spilocephalus*, the nearest relative of *podarginus*. Furthermore, all the characters listed by Yamashina are merely expressions of a single tendency, namely, a reduction of feathering. To put it in every-day language, *Otus spilocephalus*, which is a mountain bird over most of its range, found its subtropical "fur coat" too hot, after it had settled in the hot lowlands of tropical Palau, and shed it. It may be going too far to include *podarginus* in the species *spilocephalus*, but there is certainly no excuse for separating it generically. The reduction of the feathering in *luciae* (Borneo) was noted by Sharpe 50 years ago and caused him to separate this form generically as *Heteroscops* (1889, Ibis, p. 77). The very same reasons that induced subsequent authors to reject *Heteroscops* are valid against the recognition of *Pyrrhoglaux*.

MOCHTHOPOEUS HARTERT AND CRYPTIGATA MATHEWS

In October, 1927, the Whitney Expedition discovered a new leaf warbler in the mountains of Kulambangra, Solomon Islands, which was subsequently described by Hartert as a new species and genus *Mochthopoeus amoenus* (1929, Amer. Mus. Novitates, no. 364, p. 12). The species *amoenus* is so similar to *Phylloscopus trivirgatus* in every respect that it is a little hard to understand how anyone with as sane a concept of the genus as Hartert could have made it the type of a separate genus. It differs from *becki* and the other Solomon Islands forms of *Phylloscopus* by its much darker color, by having a bigger and broader bill, and by its shorter tail. In these respects *amoenus* is merely a super-"*Cryptigata*." However, I have shown (1944, Bull. Amer. Mus. Nat. Hist., vol. 83, pp. 158-159) that the characters of the so-called "genus" *Cryptigata* are nothing but the reactions of *Phylloscopus* to a sedentary life in the humid tropics. It results in softer plumage, rounder wing, and shorter tail, and longer and stronger body appendages (bill, bristles, legs, toes, and claws). These characters are not only correlated directly with the tropical environment, but, at least to some extent, with one another. Furthermore, these characters are subject to geographical variation, as I have shown (*loc. cit.*). They cannot be used as specific criteria, much less as generic ones.

The length of the tail of *amoenus* is 66.3, 67.2, 67.8 per cent of that of the wing. In *Phylloscopus* (*trivirgatus*) *becki* it is: male, 73.5, 75.7, 76.7, 79.3 (Guadalcanal), male, 71.8, 73.3, 75.4 (Malaita), female, 70.4, 71.7, 72.3 per cent (Malaita). In *bougainvillei* it is: male, 71.4, 71.5, 71.5, 72.4, 72.4, 74.2, 75, 75.7, 75.8, female, 71, 72.2 per cent. In *pallescens* it is 69.7 per cent. The individual variability in the three Solomon Islands forms thus bridges the gap between *amoenus* and the more long-tailed members of the genus *Phylloscopus*. The wing of *amoenus* is 58–59.5, not 88.5–90 as stated erroneously by Hartert in the original description. The tail measures 38.5, 40, 40, the bill (from base) 15, the tarsus 22 mm.

The joint occurrence on Kulambangra of *Phylloscopus amoenus* and *Ph.* (*trivirgatus*) *pallescens* is another instructive example of a successful double invasion. A complete revision of the *trivirgatus* group is required before the nearest relative of *amoenus* can be found. When the second wave of *trivirgatus* reached Kulambangra, the first one (*amoenus*) had already acquired specific isolating mechanisms. There is some evidence that the same two waves also swept New Guinea, but produced only hybrid populations.

MALACOLESTES MAYR AND MYIOLESTES BONAPARTE

In 1933 (Amer. Mus. Novitates, no. 590, p. 5) I separated the morning bird of Palau (*Rectes tenebrosus* Hartlaub and Finsch) generically under the name *Malacolestes*. The chief characteristics of this species, as compared to *Myiolestes megarhynchus*, are its more pointed wing with a longer first primary, its longer bill, and its much softer plumage. These characters are unmistakable, but I have since come to the conclusion that they are not sufficient for generic separation. The species *tenebrosus* is clearly derived from the New Guinea species *megarhynchus*, and it would be misleading to conceal this close relationship by generic separation. The special characteristics of *tenebrosus* are due to its isolation on the Palau Islands.

A renewed examination of the relatives of *megarhynchus* shows clearly that not even the genus *Myiolestes* can be maintained as distinct from *Colluricincla*. As far as proportions are concerned, there is nearly as much difference between the various forms of the species (or superspecies) *Colluricincla phaea* (=*harmonica*) as between the species of the "genera" *Colluricincla*, *Myiolestes*, and *Malacolestes*. The relative tail length (length of tail in per cent of length of wing) of various species and subspecies of the *Colluricincla* group is as follows (adult males only): *woodwardi*, 89.6; *tachycrypta*, 88.5; *parvula*, 81.6, 83.8; *phaea*, 80.4; *megarhyncha*, 79, 81.5; *obscura*, 77.3; *boweri*, 76.2, 78.5; *rufiventris*, 71.3, 78.8; and *tenebrosa*, 71.7, 72.3, 73. The species *tenebrosa* has, thus, clearly the shortest tail, but the difference between it and *megarhyncha* is less than between *tachycrypta*, *rufiventris*, and *phaea*, all three belonging to a single species or superspecies.

The shape of the wing shows the same. By measuring the difference between the longest and shortest primary and determining what percentage of the total wing length this distance is, the following sequence of wing tip indices is obtained: *rufiventris*, 23.1, 27; *phaea*, 23.1; *boweri*, 17.8, 20; *woodwardi*, 18.8; *tenebrosa*, 18.4, 18.8, 19.2; *tachycrypta*, 18; *parvula*, 17.2, 18.4, and *megarhyncha*, 14.4, 14.7. The New Guinea species *megarhyncha* has the shortest wing tip, while *tenebrosa* falls in the midst of the Australian *Colluricincla* series.

As far as the relative length of the first primary is concerned it is 60.2, 60.6, 62 per cent of the total wing length in *tenebrosa* and 59.8, 60, 62.2 per cent in *megarhyncha*, which falls well within the range of the Australian species (58.6–66.4 per cent). The shape of the bill, the shape of the tail feathers, the bristles at the base of the bill in *tenebrosa* and *megarhyncha* are as in the Australian species of *Colluricincla*. The plumage of *tenebrosa* is distinctly softer and silkier than that of *megarhyncha* or of the Australian *Colluricincla*, but I do not consider this character as of decisive generic value.

I propose, for the stated reasons, not to recognize the monotypic genera *Myiolestes*

Bonaparte and *Malacolestes* Mayr, and to include the species *megarhyncha* and *tenebrosa* in the genus *Colluricincla*.

MELIPHACATOR MATHEWS

In 1932 (Amer. Mus. Novitates, no. 516, p. 3) I gave a description of this "genus" which had been proposed by Mathews (without description) for the species *Ptilotis provocator* Layard. Since that time I have examined many species of the genera *Meliphaga* and *Xanthotis* and have come to realize that the species *provocator* has no character that would justify its separation in a distinct genus. In fact, the similarity between *provocator* and some forms of *Xanthotis*, as, for example, *X. chrysotis macleayana*, is quite striking and indicates close relationship. I propose, therefore, to include *provocator* in the genus *Xanthotis*.

AMOROMYZA RICHMOND AND LEPTOMYZA STEJNEGER

When Verreaux and des Murs discovered in 1860 the giant honey-eater of New Caledonia, they named it *Leptronis aubryanus*, indicating by this nomenclature that they recognized its close relationship to the Samoan giant honey-eater, *L. samoensis*. Subsequently the species was separated generically by Stejneger under the name *Leptomyza* (1885). Since then it has been found that both names (*Leptornis* and *Leptomyza*) are homonyms of earlier names. The New Caledonian bird was renamed *Gymnomyza* by Reichenow (1914, Jour. Ornith., vol. 62, p. 488) and the Polynesian bird *Amoromyza* by Richmond (1917, Proc. U. S. Natl. Mus., vol. 43, p. 593). "*Amoromyza*" actually consists of two geographically representative species on Samoa (*samoensis*) and Fiji (*viridis*) [see Mayr, 1932, Amer. Mus. Novitates, no. 516, pp. 1–3].

The difference between *aubryana* and *samoensis-viridis* is primarily one of size and of the feathering of the face. The wing length of *aubryana* is 20 per cent greater than that of *samoensis*, the tail is longer and more graduated, the bill is more robust. *G. aubryana* has a naked area on the sides of the head, between eye and ear-coverts, while this area is feathered in *samoensis-viridis*. Aside from this slight difference, *aubryana* and *samoensis* are strikingly alike in general proportions, feather structure, and habits. It seems contrary to all principles of classification to separate such close relatives generically. I, therefore, consider *Amoromyza* Richmond a synonym of *Gymnomyza* Reichenow.

In fact, combining *Gymnomyza* with *Melidectes* Sclater, a genus of Papuan honey-eaters, might even be suggested. In this genus also there is considerable variability in the feathering of the sides of the face. However, all the species of *Melidectes* (five species and superspecies) have a more slender bill, more slender and relatively longer tarsi, and much softer feathers. It seems probable that *Gymnomyza* is a descendant of *Melidectes* (I know of no other close relative), but the separation seems to have occurred at such an early age that the divergence has reached generic level.

Both facial pattern and size indicate that *G. aubryana* is a more specialized species than the *G. samoensis-viridis* group. It is, therefore, probable that the original *Melidectes*-like ancestor colonized central Polynesia directly from the New Guinea region, and that New Caledonia was colonized from central Polynesia at a later date.

THE GENERA OF MICRONESIAN WHITE-EYES

The islands of Micronesia are rich in white-eyes. The "Handlist of Japanese birds" (1932) recognizes no fewer than 10 species with 14 subspecies. Stresemann, in his revision of the Indo-Australian Zosteropidae (1931, Mitt. Zool. Mus. Berlin, vol. 17, pp. 201–238), arranges them in three groups, the species *conspicillata* (*ibid.*, p. 227), the Artenkreis *ponapensis-oleaginea-ruki* (*ibid.*, p. 230), and the genus *Megazosterops* (*ibid.*, p. 235), to which is to be added the subsequently (November, 1931) described genus *Rhamphozosterops*. A study of the Micronesian white-eyes has convinced me that Stresemann's classification does not give a true picture of the relationship of these forms. There is no question concerning *Z. conspicillata* which is a typical white-eye. Its geographical races are *saipani* Dubois (Saipan, Tinian), *rotensis* Takatsukasa and Yamashina, 1931 (Rota), *conspicillata* Kittlitz (Guam), *semperi* Hartlaub and Finsch (Palau), *hypolais* Hartlaub and Finsch (Yap), *owstoni* Hartert (Truk), and *takatsukasai* Momyiama, 1922 (Ponape). The classification of the other seven forms is quite confused. When Hartlaub described the Palau species *finschi* (1868, Proc. Zool. Soc. London, p. 6) he separated it in a separate genus *Tephras*. The characters he gave were as follows: "Differs from *Zosterops* in its differently formed beak, in the tail (which is rotundate in *Tephras*, emarginate in *Zosterops*), in the different form of the tail-feathers, in the less pointed wing, and in the want of an eye-ring." Four years later (1872, Proc. Zool. Soc. London, p. 96) Hartlaub and Finsch admit that the listed characteristics occur also in many other species of true *Zosterops*, and recognize no longer the genus *Tephras*. The white eye-ring, for example, is wanting in *Zosterops lutea uropygialis*, *Z. rennelliana*, *Z. rendovae*, *Z. stresemanni*, *Z. inornata*, *Z. sanctaecrucis*, and others. Still, no one has proposed separating these species generically from *Zosterops*. The three forms *cinerea*, *ponapensis*, and *finschi* are so similar to one another, with *ponapensis* exactly intermediate between *cinerea* and *finschi*, that I do not hesitate to consider all three conspecific. Hartert (1900, Novit. Zool., vol. 7, p. 3) associated with this species also his Truk Island white-eye (*ruki* Hartert), and Stresemann (*tom. cit.*), follows him in this arrangement. After a close study of the characters of the various forms I have come to the conclusion that *ruki* has nothing to do with *cinerea-finschi*, but that it is closely related to *Megazosterops palauensis* Reichenow and *Rhamphozosterops sanfordi* Mayr, as well as to "*Zosterops*" *oleaginea* Hartlaub and Finsch (Yap).

The evidence is as follows: All four species are large, much larger than either *cinerea* or *conspicillata*. The wing measurements are: *palauensis*, 81-83; *oleaginea*, 65.6 (*fide* Hartlaub and Finsch); *ruki*, 78-83; and *sanfordi*, 68-71. The iris of the four species is as follows: grayish in *palauensis*, reddish white in *oleaginea*, reddish in *ruki*, and brown in *sanfordi*. The legs are tan colored in *palauensis*, and yellowish orange in the other three species. The voices of *palauensis* and *sanfordi*, the only two species of which the voice is described, are very similar, "a musical, deep-throated sibilation" (Coultas), quite unlike that of any other white-eye. A white eye-ring is present in *oleaginea*, it is barely indicated in *palauensis*, and is more or less lacking in *ruki* and *sanfordi*. The proportions of the three species *palauensis*, *ruki*, and *sanfordi* (*oleaginea* was not examined) are very much the same, the tail length is about 62–63 per cent of the wing length, the tarsus about 31–32 per cent of the wing length. The only striking difference among the three species is the shape of the bill. The species *palauensis* and *ruki* (presumably also *oleaginea*) have a typical *Zosterops* bill, although it is rather heavy in these large birds. The bill of *sanfordi*, on the other hand, is elongated and curved, resembling that of a honey-eater (Meliphagidae). The length of the bill (from the lateral beginning of feathering to the tip) is 18.5 per cent in *ruki* and *palauensis*, as against 26.1 per cent of the wing length in *sanfordi*. The shape of the wing (wing formula) and the shape of the tail seem to be identical in the three species.

The conclusion to be drawn from this evidence is as follows: There are several species of large white-eyes in Micronesia, which seem to be more closely related to each other than to any of the typical white-eyes of the genus *Zosterops*. A number of features are peculiar to each of the species, like the slender, curved bill of *sanfordi* and the white eye-ring of *oleaginea*, but these differences are not striking enough to justify the generic division of this group. Ultimately it might be preferable to include all these species in the genus *Zosterops*, but at present it would seem best to recognize for them the genus *Rukia*.

The generic names *Rukia* (for *ruki*) and *Kubaryum* (for *oleaginea*) were published simultaneously in the same publication. As first reviser I select the name *Rukia*, which not only is shorter but is also based on a species which I have been able to examine. The large Ponape white-eye was described almost simultaneously by myself and by Takatsukasa and Yamashina. The number of the Ornithologische Monatsberichte in which the description of *Rhamphozosterops sanfordi* Mayr was published was actually mailed on November 4, 1931. The earliest mailing date of any copy of the issue of the Dobutsugaku Zasshi, containing the description of *Cinnyrorhyncha longirostra* Takatsukasa and Yamashina, which I have been able to ascertain, is November 23, 1931. This I have established by correspondence with the leading American and European ornithologists and libraries. The assertion of Japanese friends of the authors of *Cinnyrorhyncha* that they had seen copies of the description prior to November 23 seems hardly sufficient evidence to accept an earlier publication date. I, therefore, use the name *sanfordi* as having priority over *longirostra.*

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NEW SPECIES AND SUBSPECIES OF BIRDS FROM VENEZUELA. 1

By John T. Zimmer and William H. Phelps

A study of part of the Phelps Collection, established in Caracas, Venezuela, has revealed the existence of a number of new subspecies and one new species, the decriptions of which are given in the following paper.

The junior author wishes to express his thanks to the personnel of the Department of Birds of the American Museum of Natural History for their coöperation in facilitating the comparison of his material with that in the Museum. In the lists of specimens examined, the examples in the Phelps Collection or in various other institutions are so characterized; the remaining material is in the American Museum of Natural History.

Names of colors are capitalized when direct comparison has been made with Ridgway's "Color standards and color nomenclature."

Rallus longirostris margaritae, new subspecies

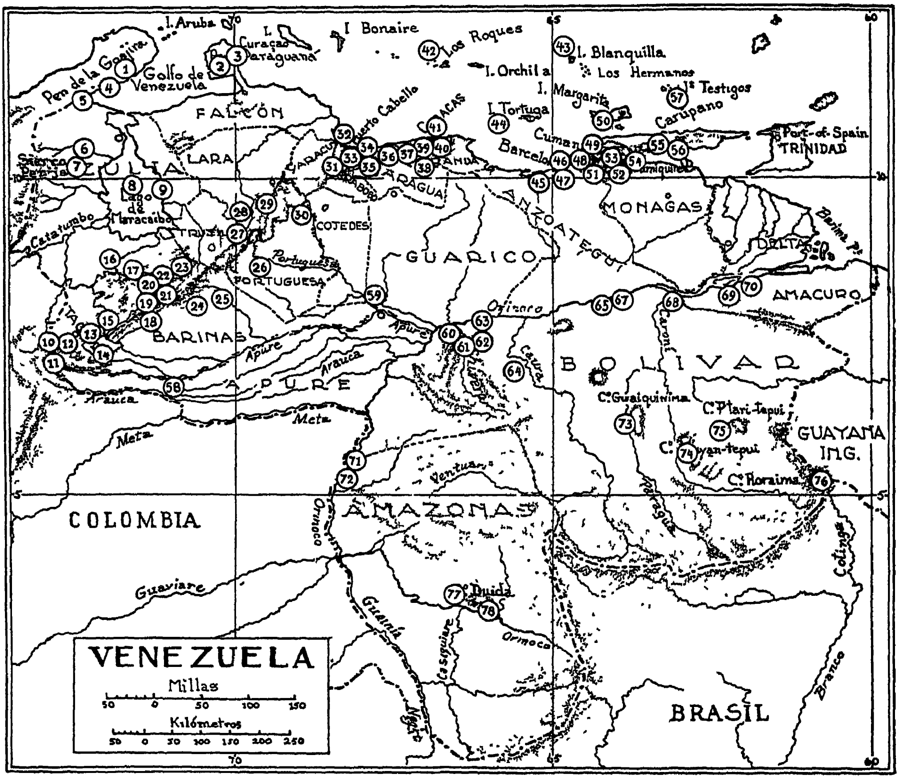
Type: From Boca del Río, Margarita Island, Venezuela; at sea level. No. 23997, Phelps Collection, Caracas. Adult male collected October 9, 1943, by Fulvio Benedetti and William H. Phelps, Jr. (Type on deposit at the American Museum of Natural History.)

Diagnosis: Nearest to *R. l. pelodramus* from Trinidad but the upper parts blacker, with the edgings to the feathers narrower and more brownish, less grayish, and the breast redder, less buffy.

Range: Known only from the type locality and the nearby Laguna de Arestinga.

Description of Type: Top of head and foreneck brownish black with glossy black shafts but with little suggestion of paler margins to the feathers; hind neck black with distinct paler edges to the feathers; back black with the feathers narrowly margined with Buffy Brown × Olive-Brown; uropygium and tail-feathers similar, more narrowly margined with the same color; a faint Fawn Color stripe above lores; lores and sides of head Chaetura Drab; a whitish suborbital lunule; chin white; malar stripe, upper throat, and upper abdomen light Fawn Color, slightly shaded on lower throat and breast; flanks, sides of abdomen, axillaries, under wing-coverts, and shorter under tail-coverts brownish black with white bars about half the width of the dark interspaces; longer under tail-coverts white; under aspect of tail brownish black; wings blackish brown; inner remiges approaching the color of the back; upper wing-coverts Verona Brown. Maxilla (in life) "black"; mandible "coral with black tip"; feet pale brown; iris "yellowish-brown." Wing, 132 mm.; tail, 49; exposed culmen, 55; culmen from base, 60; tarsus, 45.5.

Remarks: Size similar to *pelodramus*. Sexes alike in coloration but male slightly larger. Range of measurements: two males: wing, 132, 121 mm.; tail, 49, 47; exposed culmen, 55, 50; tarsus, 45.5, 45; three females: wing, 120, 120, 114; tail, 47, 44, 43; exposed culmen, 48, 51.5, 48; tarsus, 43.5, 44, 42. The new form has the blackest back of all the races, while *phelpsi*, from the Goajira and Paraguaná peninsulas, is among the lightest in coloration. The species has not been recorded from the Orinoco Delta or from the mainland of northeastern Venezuela, but it is probable that either *pelodramus* of Trinidad or *longirostris* of the Guianas occurs there. The birds were not uncommon in the large mangrove lake of Arestinga, in the middle of the south shore of the island, but they had been overlooked by previous collectors.



30	Acarigua
65	Agua Salada de Ciudad Bolívar
63	Altagracia
46	Bahía de Guanta
47	Barcelona
25	Barinas
51	Bergantín
43	Blanquilla Island
15	Boca de Monte, Pregonero
35	Boca de Río, Lake Valencia
77	Boca de Sina
50	Boca del Río, Margarita Island
60	Caicara
59	Camaguan
71	Caño Cataniapo
61	Caño Guaniamo, R. Cuchivero
39	Caracas
54	Caripe
4	Castilletes
27	Cendé, Páramo Cendé
39	Cerro del Avila
38	Cerro Golfo Triste
54	Cerro Negro, Caripe
67	Ciudad Bolívar
24	Ciudad Bolivia, Barinas
31	Colonia Chirgua
36	Colonia Tovar
39	Cotiza, Caracas
29	Cubiro
49	Cumaná
53	Cumanacoa
33	Cumbre Chiquita
33	Cumbre de Valencia
40	Curupao
21	Duraznos
19	Egido
36	El Limón, Puerto La Cruz
51	El Peonío, Bergantín
55	El Pilar
27	El Rincón, Cerro Niquitáz
22	El Valle, Mérida
17	El Vigía
39	Galipán
1	Goajira Peninsula
26	Guanare
46	Guanta
55	Guaraúnos, El Pilar
40	Guarenas
58	Guasdualito
40	Hacienda Izcaragua, Guarenas
35	Hacienda Santa Clara, Aragua
46	Isla de Cachicamo
37	Junquito
3	La Boca, Adícora
35	La Cabrera
34	La Ciénaga, Aragua
20	La Culata
12	La Ortiza, Táchira
39	La Silla, Caracas
50	Laguna de Arestinga
8	Lake Maracaibo
35	Lake Valencia
39	Las Canoas, Cerro del Avila
10	Las Delicias, Táchira
61	Las Guacas
6	Las Múcuras
33	Las Quiguas
36	Limón (El Limón)

Rallus wetmorei, new species

TYPE: From La Ciénaga, Venezuela; between Ocumare de la Costa and Turiamo, Aragua. No. 20431, Phelps Collection, Caracas. Adult (breeding) female collected April 11, 1943, by William H. Phelps. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Somewhat similar to *Rallus longirostris pelodramus* of Trinidad, but upper parts slightly browner, less blackish, and lateral under parts without barring; ventral coloration duller and more uniform; throat and belly less conspicuously different from the breast and sides; under wing-coverts virtually uniform; wing and tarsi shorter; outermost primary relatively slightly shorter.

RANGE: Known only from the type locality.

DESCRIPTION OF TYPE: Top of head sooty brown, nearly uniform, with only faint suggestions of paler margins on the feathers; back of head like the crown, with the hind neck, posteriorly, and the back with Fuscous Black centers on the feathers, broadly margined with Buffy Brown; uropygium with margins darker and relatively broader, largely concealing the dark centers; upper tail-coverts much like the back. A narrow stripe over lores and anterior half of orbit, Avellaneous; lores dull grayish; a whitish suborbital lunule; rest of sides of the head Hair Brown, lightening to Drab on the lower part of the malar region; chin Tilleul Buff; upper throat near Vinaceous-Buff, darkening to Wood Brown × Drab on breast, sides, and upper belly; sides of neck with traces of dusky stripes merging into the color of the hind neck; lower belly narrowly light Vinaceous-Buff; flanks virtually uniform Buffy Brown with faint suggestions of fine white subterminal and terminal margins on the hindermost feathers; shorter under tail-coverts Buffy Brown with narrow whitish bars; longer ones with brownish tips or edges on exposed portions, concealing the extensive white areas of the remainder of the feathers. Wings dark brown; primaries nearly uniform; secondaries and tertials with blackish median portions and paler margins, matching the colors of the back; upper wing-coverts largely uniform light Buffy Brown with some traces of dark centers; under wing-coverts Wood Brown —one or two feathers with faint suggestions of white at the tips; outer primary about equal to the tenth (from the outside); second shorter than the sixth; fourth longest. Tail blackish with brown margins much like upper tail-coverts. Iris (in life) "reddish brown"; maxilla "dark olive"; mandible "brown with olive tip"; feet "pale olive brown"; tongue and inside of mouth "orange." Bill relatively straight and slender. Wing, 115 mm.; tail, 44; exposed culmen, 47; culmen from base, 50; depth of bill at base, 12; tarsus, 41.5.

REMARKS: While we are describing this bird as a full species, there is a possibility that it will prove to be only an exception-

23	Llano Rucio, Mérida
48	Los Altos, Sucre
52	Los Palmales
42	Los Roques Islands
9	Mene Grande
21	Mérida
74	Mt. Auyan-tepui
28	Mt. Bucarito
78	Mt. Duida
73	Mt. Guaiquinima
75	Mt. Ptari-tepui
76	Mt. Roraima
37	Ño León
34	Ocumare de la Costa
70	Orocoima
5	Paraguaipoa
2	Paraguaná Peninsula
11	Páramo de Tamá Camp
22	Páramo San Antonio
45	Píritu
46	Puerto La Cruz, Anzoátegui
39	Quebrada de Catouche, El Avila
13	Queniquea
22	Quintero
52	Rincón de San Antonio
61	Río Mato
69	Sacupana
68	San Félix, Bolívar
41	San José de los Caracas (Los Caracas)
72	Sanariapo
18	Santa Bárbara, Barinas
16	Santa Bárbara, Zulia
62	Santa Rosalía, Bolívar
14	Santo Domingo
22	Tambor (Páramo Tambor)
57	Testigos Islands
44	Tortuga Island
32	Tucacas
34	Turiamo
10	Villa Paéz
7	Villa del Rosario
56	Yaguaraparo

ally well-marked subspecies of *longirostris*. The allocation may well await the presence of a series of specimens to see if the characters show any greater approach to those of the *longirostris* group than are exhibited by the unique type. The almost complete absence of barring on the flanks, so prominent in all forms of *longirostris*, at least in adult specimens, and the generally uniform under parts give this bird a very distinctive appearance, although the upper parts match the pattern of some forms of *longirostris* as well as those of some other species of the genus. At present it is safe to say that *longirostris* appears to be its closest relative.

The specimen was collected in a mangrove swamp of about a square mile in area on the western shore of the uninhabited bay called La Ciénaga. As the specimen was apparently breeding, from the condition of the ovaries, and as a new form of *Dendroica petechia* had been found in the same swamp, many collecting trips were subsequently made to the locality in a vain effort to find additional specimens.

This species has been named in honor of Dr. Alexander Wetmore, Secretary of the Smithsonian Institution, in recognition of his valuable contributions to Venezuelan ornithology and of his interest in, and help to, the Phelps Collection.

SPECIMENS EXAMINED

R. l. phelpsi.—VENEZUELA (Phelps Collection): La Boca, Adícora, Paraguaná Peninsula, 1 ♂, 1 ♀.

R. l. margaritae.—VENEZUELA (Phelps Collection): Boca de Río, Margarita Island, 1 ♂, 2 ♀; Laguna de Arestinga, Margarita Island, 1 ♂, 1 ♀.

R. l. pelodramus.—TRINIDAD: 4 ♂, 4 ♀, 1 (?).

R. l. longirostris.—BRITISH GUIANA (Chicago Natural History Museum): Buxton, 1 ♀; (U. S. National Museum): "Demerara," 1 (?).

R. l. crassirostris.—BRAZIL: 1.

R. l. cypereti.—ECUADOR: 2.

R. l. crepitans.—U. S. ATLANTIC COAST: 69.

R. l. waynei.—NORTH CAROLINA to FLORIDA: 47.

R. l. scottii.—GULF COAST OF FLORIDA: 18.

R. l. corrius.—BAHAMA ISLANDS: 4.

R. l. cubanus.—CUBA: 10.

R. l. caribaeus.—JAMAICA: 1.

R. l. manglecola.—ANTIGUA: 1.

R. l. saturatus.—TEXAS: 7.

R. l. pallidus.—YUCATAN: 1.

R. wetmorei.—VENEZUELA (Phelps Collection): La Ciénaga, 1 ♀ (type).

Pyrrhura hoematotis immarginata, new subspecies

TYPE: From Cubiro, State of Lara, Venezuela; altitude 1800 meters. No. 5186, Phelps Collection, Caracas. Adult male collected November 27, 1939, by Alberto Fernández Yépez. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Differs from *P. h. hoematotis* of the Caracas region in lacking the interrupted collar of brownish feathers, with light edges, on side of neck. Also lacks the ochraceous tinge or spots on the nape, which is green, nearly uniform with the back. The dusky barring on throat and breast is much fainter, almost obsolete.

RANGE: Known only from the type locality in the Subtropical Zone of the State of Lara.

DESCRIPTION OF TYPE: Forehead Deep Bluish Gray-Green, turning to green against the bill; rest of upper parts uniform bright Grass Green with a yellowish sheen; sides of head and under parts paler, Yellowish Oil Green; a bare eye ring; ear-coverts Madder Brown with green tips; a faint scalloped appearance to the breast as the feathers have light subterminal bands (but no dark margins as in *hoematotis*); a reddish patch in center of abdomen, uniform in color with ear-coverts; lower flanks and under tail-coverts more bluish green. Remiges brown with outer vanes and outer half of inner vanes of upper surface of primaries, except the first, and the tips of the others, Chessylite Blue, Jouvence Blue on the edges; outer vane and outer half of inner vane of secondaries like the back, becoming bluish at base; upper wing-coverts like the back; greater under wing-coverts and under side of remiges, Neutral Gray, the lesser coverts green, uniform with the under parts. Tail strongly graduated, Garnet Brown × Maroon, becoming greenish at base; tips dull yellowish, shafts black above, reddish brown beneath. Bill (in life) "white"; feet "gray"; iris "light brown." Wing, 133 mm.; tail, 114; exposed culmen, 19; culmen to base of cere, 17.5; tarsus, 14.5.

REMARKS: Sexes alike. Size similar to

hoematotis. Range of measurements: two males: wing, 133, 126.5 mm.; tail, 114, 102; exposed culmen, 19, 19.5; two females: wing, 133.5, 129; tail, 105, 104; exposed culmen, 18, 19.

Hitherto the species has been known only from the Caracas region. Inasmuch as the subspecies inhabiting the mountains of southern Lara are usually characteristic ones of the Mérida avifaunal region, it is not surprising that the extension of range of the present species shows a new form.

Souancé, in his description of the species, gave "Venezuela" as the habitat. We designate Caracas as the restricted type locality. The original description mentions the "golden green" nape and scalloped gray and black collar on the sides of the neck, both of which are characteristic of *hoematotis* and not found on the new *immarginata*.

Specimens Examined

P. h. hoematotis.—Venezuela: Junquito, 1♂. Venezuela (Phelps Collection): Colonia Tovar, 7 ♂, 7 ♀; Ño León, 1 ♀; Junquito, 2♂, 1♀; Curupao, 5♂, 2♀, 1 (?).

P. h. immarginata.—Venezuela (Phelps Collection): Cubiro, Lara, 2♂ (including type), 2 ♀.

Picumnus cinnamomeus perijanus,
new subspecies

Type: From Las Múcuras, Río Palmar, Perijá, State of Zulia, Venezuela; altitude 60 meters. No. 325222, American Museum Natural of History (by exchange from the Phelps Collection). Adult male collected March 10, 1940, by Ventura Barnés, Jr.

Diagnosis: Similar to *P. c. cinnamomeus* of the arid coast region of northern Colombia and northwestern Venezuela but darker, both above and below, and the white spots on the posterior part of the crown in the male less prominent. The female also differs in having the white spots throughout the black crown instead of being limited to the posterior area. Differs from *P.c.venezuelensis* of the humid forested area at the head of Lake Maracaibo in having the forehead lighter, Maize Yellow instead of Amber Brown, and the other plumage likewise not so dark.

Range: The lowlands of the middle western and eastern shores of Lake Maracaibo.

Description of Type: Forehead Maize Yellow; crown black with yellow tips to the feathers forming elongated spots, the most posterior ones being white; nape, back, and rump Chestnut × Burnt Sienna; wing-coverts brown edged with chestnut; remiges brown, the secondaries edged with whitish; rectrices brownish black, the central pair with white inner vanes and a white diagonal bar across the outer pair; sides of head and under parts Chestnut × Burnt Sienna; under wing-coverts Pale Pinkish Buff. Bill (in life) "black"; feet "black"; iris "brown." Wing, 52.5 mm.; tail, 27; culmen from base, 13.5; tarsus, 13.

Remarks: Size similar to that of the other two forms. Range of measurements: four males: wing, 52–54 (52.7); tail, 26–27 (26.2); culmen from base, 13–13.5 (13.2); six females: wing, 52–55 (53.1); tail, 26–28 (27.6); culmen from base, 12–13 (12.4).

The females differ from the males only in the replacement of the linear yellow crown spots by rounded white ones.

The population at Mene Grande, on the eastern shore of Lake Maracaibo, is intermediate in coloration between the new form and *cinnamomeus*, but the spotting on the crown of both the male and female is definitively that of *perijanus*.

The three specimens of *cinnamomeus* in the Phelps Collection from Paraguaipoa at the base of the Goajira Peninsula, are lighter, both above and below, than the six in the American Museum of Natural History from Bonda (Santa Marta), the lower Magdalena and Cartagena (topotypical).

The distribution of the three forms on Lake Maracaibo is: *cinnamomeus* at the northern end in the arid coastal region; *perijanus* in the intermediate zone on both sides of the lake; and *venezuelensis* in the humid forested area at the southern end.

Specimens Examined

P. c. cinnamomeus.—Colombia: Cartagena, 1♀; northern Antioquia, 1♀; Varrud, lower Magdalena, 1♂; La Playa, near Barranquilla, 1 ♂; Bonda, 1 ♂, 1 ♀. Venezuela (Phelps

Collection): Paraguaipoa, Goajira Peninsula, 1 ♂, 2 ♀.

P. c. perijanus.—Venezuela: Las Múcuras, 1 ♂ (type), 1 ♀. Venezuela (Phelps Collection): Las Múcuras, 1 ♂, 1 ♀; Villa del Rosario, 1 ♂, 1 ♀; Mene Grande, 1 ♂, 3 ♀.

P. c. venezuelensis.—Venezuela (Phelps Collection): Santa Bárbara, Zulia, 3 ♂.

Picumnus squamulatus röhli,
new subspecies

Type: From Cotiza, Caracas, Venezuela; altitude about 1000 meters. No. 150299, American Museum of Natural History. Adult male collected August 19, 1918, by George K. Cherrie; original no. 20358.

Diagnosis: Similar to *P. s. squamulatus* of eastern Colombia but whiter below, with the dusky squamulations much less prominent, and the chin whiter, almost free from markings. Differs from *P. s. obsoletus* of extreme northeastern Venezuela in having a different pattern on the back, which has the feathers pale brown with stronger dusky terminal margins instead of pale olive with more prominent dusky centers but weaker edges; the under parts are whitish with only a slight tinge of yellow and with little trace of shaft spots on the sides, instead of pale yellow with prominent dark shaft spots or streaks.

Range: Western Venezuela from Perijá, the Andes of Mérida, and the upper Apure Valley eastward through the Caracas region to Caripe in the mountains of northeastern Venezuela, in the Tropical and Lower Tropical Zones from sea level to 1800 meters.

Description of Type: Crown black, the anterior feathers and those of the forehead with elongated light Flame Scarlet spots; these spots on posterior and occipital feathers white and rounded; nape browner, with buffy spots; back and rump Tawny-Olive, the feathers with dusky edges giving a scalloped appearance; upper tail-coverts buffy white with dusky tips. Lores white tinged with buff, uniting with the white malar region; an inconspicuous superciliary stripe whitish; auriculars light brown with pale tips; a whitish postocular stripe; chin white; rest of under parts white, slightly tinged with pale buff, the feathers of breast and abdomen narrowly edged with black, giving a squamulated appearance. Remiges fuscous, the primaries narrowly edged with brown and the secondaries broadly edged with Olive-Buff; primary coverts dark brown; upper wing-coverts like the back; under wing-coverts, axillaries, and basal edge of inner vanes of remiges Cartridge Buff with fine dusky tips. Tail black, inner vane of central feathers white; a diagonal white bar through the two outer pairs. Bill black, slaty at lower base; feet dull brownish. Wing, 54 mm.; tail, 27.5; exposed culmen, 10; culmen from base, 11.9; tarsus, 13.

Remarks: Size similar to *P. s. squamulatus* and *P. s. obsoletus.* Range of measurements: 12 males: wing 51–55 (53.3) mm.; tail, 23–28 (26.1); culmen from base, 11–13 (12); six females: wing, 50–55 (51.7); tail, 23–26 (24.7); culmen from base, 11–12.5 (11.7).

The female differs from the male in having the elongated orange red or yellow spots on the forehead replaced by small round white ones uniform with those of the back of the head.

The entire Venezuelan population of this species has long been called *obsoletus.* That form was described from one specimen, and a topotypical series has never been collected until now. This series from El Pilar, Guaraúnos near El Pilar, and Yaguaraparo shows that the birds from this region are quite distinct from those from all the other Venezuelan localities. The four new specimens of *obsoletus* from El Pilar are similar to the type with a tendency towards black speckling below in addition to the faint squamulations. The five Yaguaraparo specimens have this speckling more accentuated.

The speckling on the crowns of the males is sometimes Lemon Chrome and sometimes orange-red but this does not seem to have any geographic significance. In the series from northeastern Venezuela, five males have orange-red crown-spots while seven have yellow ones, and both colors occur in the same locality. However, all eight males from the Mérida and Caracas regions have orange-red crown-spots. All of the males of *obsoletus* and *squamulatus* have the spots orange-red.

We have named this bird in honor of Señor Eduardo Röhl, Director of the Astronomical Observatory at Caracas, who initiated the study of modern ornithology in Venezuela.

SPECIMENS EXAMINED

P. s. squamulatus.—COLOMBIA: Villavicencio, 3 ♂, 1 [♀]; Buena Vista, 2 ♂, 3 ♀, 1 (?); Quitamo, 1 ♂; "Bogotá," 6 [♂], 2 [♀]; Llanos de Río Meta, 2 [♂].

P. s. rohli.—VENEZUELA: La Ortiza, Táchira, 1 [♂], 1 [♀]; Egido, Mérida, 2 [♂], 1 [♀]; Tucacas, 1 ♂; Las Quiguas, 1 ♂; Cumbre Chiquita, 1 ♂, 1 ♀, 1 [♀]; La Silla, 1 ♀; Cotiza, Caracas, 1 ♂ (type), 2 ♀; "Cumaná," 1 ♂, 1 ♀; Rincón de San Antonio, 2 ♀; Cumanacoa, 3 ♂, 1 ♀; Los Palmales, 1 ♂; Caripe, 1 [♂], 1 [♀]. VENEZUELA (Phelps Collection): Ciudad Bolivia, Barinas, 1 ♂; El Vigía, Mérida, 1 ♀; Barcelona, 3 ♂, 1 ♀; Los Altos, 1 ♂; Caripe, 1 ♂, 2 [♂].

P. s. obsoletus.—VENEZUELA: El Pilar, 1 ♂ (type). VENEZUELA (Phelps Collection): El Pilar, 1 [♂]; Guaraúnos, El Pilar, 1 ♂, 1 ♀; Yaguaraparo, 2 ♂, 4 ♀.

Certhiaxis cinnamomea valenciana, new subspecies

TYPE: From La Cabrera, Lake Valencia, Venezuela; altitude 400 meters. No. 18979, Phelps Collection, Caracas. Adult male collected July 24, 1942, by William H. Phelps. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Closest to *C. c. fuscifrons*, from northeastern Colombia, but darker above, and with less buffy suffusion on breast and flanks, which are almost pure white.

RANGE: Northwestern Venezuela on the eastern shore of Lake Maracaibo, on Lake Valencia, and in the Apure Valley in the States of Guárico, Portuguesa, and Barinas.

DESCRIPTION OF TYPE: Forehead Light Grayish Olive; rest of upper aspect deep Tawny except rump which is lighter, more grayish, merging into whitish at base of upper tail-coverts; outer primaries Olive-Brown × Clove Brown, this color decreasing gradually on the basal part of remiges until it disappears on the inner secondaries, being replaced by rufous; superciliary stripe white; lores black; postocular stripe darker than the forehead; auriculars largely whitish, darker on upper border; chin spot Amber Yellow; sides of chin, cheeks, and under parts white, very slightly tinged with buff on sides, flanks, and under tail-coverts; axillaries white tinged with buff; under wing-coverts Light Pinkish Cinnamon with traces of whitish edges; bend of wing white; tail like upper parts, shafts whitish below, rufous above. Bill (in life) "black"; feet "gray"; iris "brownish-white." Wing, 65 mm.; tail, 56.5; exposed culmen, 14; culmen from base, 18.5; tarsus, 21.

REMARKS: Sexes alike in coloration but the female with a shorter wing. Size similar to *fuscifrons*. Range of measurements: six males from type locality: wing, 64.5–67 (65.6); tail, 55–57 (56); exposed culmen, 14–15 (14.3); culmen from base, 17–20 (18.1); four females from type locality: wing, 61–62.5 (61.6); tail 53–56 (54.2); exposed culmen, 13–15.5 (14.4).

The populations of Lake Maracaibo and the Apure River region do not have the almost immaculate under parts of the Lake Valencia series of paratypes but have the breast and flanks with the pronounced buffy wash of *fuscifrons*. Therefore they are intermediates, lacking one character.

The specimen in the Phelps Collection from Guasdualito is listed as *orenocensis* but, although it has the typical dusky area on the distal portion of the inner webs of the mediam rectrices, it is different from that race in having the grayish forehead of *valenciana* although the upper parts are much darker than the new race. It may be that the population of the upper Arauca River region is an undescribed race.

SPECIMENS EXAMINED

C. c. cinnamomea.—BRAZIL: Marajó, 1 ♂; Baião, R. Tocantins, 6 ♂, 2 ♀, 1 (?). FRENCH GUIANA: 2 ♂, 1 ♀. DUTCH GUIANA: 2 ♂, 4 ♀, 3 (?). TRINIDAD: 7 ♂, 3 ♀. VENEZUELA (Phelps Collection): Barcelona, 1 ♂; Guaraúnos, El Pilar, 1 ♀.

C. c. cearensis.—BRAZIL: 13.

C. c. russeola.—BRAZIL: 7. PARAGUAY: 10. ARGENTINA: 7. BOLIVIA: 1.

C. c. pallida.—BRAZIL: 14.

C. c. orenocensis.—VENEZUELA: Sacupana, 1 (?); Ciudad Bolívar, 3 ♂, 2 ♀; Agua Salada de Ciudad Bolívar, 1 ♂, 1 (?); Altagracia, 1 ♂, 5 ♀; Las Guacas, 1 ♂, 2 ♀. VENEZUELA (Phelps Collection): Orocoima, R. Toro, 2 ♂; Guasdualito, 1 ♀.

C. c. valenciana.—VENEZUELA (Phelps Collection): La Cabrera, Lake Valencia, 8 ♂ (including type), 1 ♀; Boca del Río, Lake Valencia, 1 ♀; Mene Grande, 1 ♂, 2 ♀, 1 (?); Ciudad Bolivia, Barinas, 2 ♂, 2 ♀, 1 (?); Acarigua, 1 ♂; Camaguan, 1 ♂, 3 ♀.

C. c. fuscifrons.—COLOMBIA: Bagado, Chocó, 1 ♂, 1 ♀; Ciénaga, Santa Marta, 1 (?); La Playa, near Barranquilla, 2 ♂; Calamar, 1 ♂, 1 (?).

Syndactyla guttulata pallida,
new subspecies

TYPE: From El Peonío, Bergantín, State of Anzoátegui, Venezuela; altitude 1300 meters. No. 15567, Phelps Collection, Caracas. Adult female collected November 30, 1941, by Fulvio Benedetti. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Differs from *S. g. guttulata* of the Caracas region by paler margins on the feathers of the under parts, and paler rufous uropygium and tail.

RANGE: The Subtropical Zone in the mountains of northeastern Venezuela, from Bergantín to Caripe.

DESCRIPTION OF TYPE: Top of head and back Brownish Olive; the feathers of head with pale buff centers and dusky edges giving a faint, finely streaked appearance, more noticeable on the forehead; the feathers of back with elongated buffy whitish shaft streaks bordered by dusky; lower rump and upper tail-coverts Cinnamon-Rufous × Orange-Rufous; a buffy superciliary stripe from nostrils to hind neck, deeper anteriorly; lores black; ear-coverts dusky, pale along the shafts; feathers of malar stripe yellowish white with dusky edges giving a spotted appearance. Chin and upper throat Straw Yellow; lower throat, breast, belly, and shorter under tail-coverts with broad buffy-white stripes down the middle of the feathers, laterally margined with Buffy Olive, darker on the breast, paler on the abdomen, and with the margins on the lower throat rounding the tips of the feathers, giving a scaled appearance instead of the striped one of the rest of the under parts; flanks largely Buffy Olive, with the pale markings reduced to shaft streaks, obsolete on the posterior feathers and thighs; longest under tail-coverts pale rufous. Wing fuscous; outer edges of remiges Sayal Brown, which increases in extent until it covers the tertials; upper wing-coverts with a little brighter outer margins and tips; inner margins of remiges Light Ochraceous-Buff commencing basally on outermost primary and extending progressively towards tips on successive feathers; under wing-coverts and axillaries Ochraceous-Buff × Ochraceous Salmon; bend of wing yellower. Tail deep Hazel, paler below. Maxilla (in life) "black"; mandible "lemon"; feet "yellowish-green"; iris, "brown." Wing, 85 mm.; tail, 76; exposed culmen, 20; culmen from base, 23.5; tarsus, 23.

REMARKS: Sexes alike. Size similar to *S. g. guttulata.* Range of measurements: three male adults: wing, 89–94 (92) mm.; tail, 73–78 (75); culmen from base, 22–23 (22.3); four female adults: wing, 85–86 (85.4); tail, 69.5–76 (72.6); culmen from base, 22–23.5 (22.5).

The immature specimens differ in coloration from the adults. One male from Cerro Negro and one female from El Peonío differ in having the feathers of the chin and upper throat speckled with dusky instead of being immaculate, the superciliary stripe Ochraceous-Buff × Ochraceous-Orange, an ochraceous suffusion on breast and abdomen, and the streaks on back broader and more buffy. Two immature specimens of *guttulata,* a male and female from Cerro Golfo Triste, in the Caracas region, are similar to the above immatures of *pallida* except that they also have the subspecific characters of *guttulata,* but they have a much greater suffusion below of ochraceous. The skulls of all four of these presumably immature specimens are hard, so they are fully grown though not fully adult.

Hellmayr, in "Birds of the Americas" (1925, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 4, p. 194), says: "Four specimens from Bermúdez (Los Palmales) appear to be inseparable from the Caracas birds." We have two specimens before us from Los Palmales, and they show the subspecific characters on which the new race is based.

SPECIMENS EXAMINED

S. g. guttulata.—VENEZUELA: Cumbre de Valencia, 1 ♂, 1 ♀; El Limón, Puerto La Cruz, 1 ♂. Venezuela (Phelps Collection): Las Quiguas, 1 (?); Colonia Tovar, 1 ♂, 1 ♀; Junquito, 1 (?); Quebrada de Catuche, El Avila, 1 ♀; Las Canoas, El Avila, 1 ♂; Cerro Golfo Triste, San Casimiro, Aragua, 2 ♀ imm.

S. g. pallida.—Venezuela: Rincón of San Antonio, 2 ♀; Los Palmales, 2 ♂; "Cumana," 1 (?). Venezuela (Phelps Collection): Cerro Negro, Caripe, 1 ♂, 1 ♂ imm., 1 ♀, 1 ♀ imm.; El Peonío, Bergantín, 1 ♀ (type).

Chamaeza brevicauda obscura,
new subspecies

Type: From Mt. Auyan-tepui, State of Bolívar, Venezuela; altitude 1100 meters. No. 324715, American Museum of Natural History. Adult male collected January 25, 1938, by William H. Phelps (Phelps-Venezuelan Expedition); original no. 1086.

Diagnosis: Nearest to *C. b. fulvescens* of the Merumé Mountains of British Guiana and Mt. Roraima, Venezuela, but the back darker, more olivaceous, less rufous yellowish; the striping on the lower breast and flanks is blacker, less brownish; and the subterminal dusky bars on the rectrices are wider and blacker.

Range: Known only from the Subtropical Zone on Mts. Auyan-tepui, Ptari-tepui, and Guaiquinima, in the southeastern part of the State of Bolívar.

Description of Type: Back Dresden Brown × Prout's Brown, lighter on the uropygium and darker on the crown, quite dusky at base of culmen; all the feathers with very faint dusky edges giving an indistinct scaled appearance; feathers of crown with dusky centers; lores, postocular stripe, stripe below the dusky ear-coverts, and malar stripe buffy white; a broad dark brown stripe from in front of the eye along the sides of the neck, divided medially by a buffy stripe commencing just below the auriculars. Chin and upper throat buffy white separated from malar stripe by a row of brownish black speckles; lower throat and upper breast deep Ochraceous-Buff, the median feathers heavily edged with black, more olivaceous on the sides; rest of breast and abdomen white with a few dusky markings on the margins; flanks white with a pale buffy tinge, the feathers very heavily margined on both vanes with black, not rounding the tip; under tail-coverts Ochraceous-Buff with faint dusky markings. Wings Fuscous, paler on the inner side where the shafts are whitish, the secondaries broadly edged with the color of the back; tertials and wing-coverts uniform with back; under wing-coverts and axillaries white heavily tipped with dusky, and with a blackish patch near the bend of the wing. Tail Prout's Brown above, with a blackish subterminal band increasing in width from 3 mm. on central rectrices to 15 on the outer ones; tips of rectrices whitish except on the central ones which are uniform with the base of the tail; under aspect of tail paler with white shafts. Bill brownish black, base of mandible flesh color; feet light brown. Wing, 100 mm.; tail, 58; exposed culmen, 19.5; culmen from base, 25.5; tarsus, 41.

Remarks: Sexes alike. Size similar to *C. b. fulvescens*. Range of measurements: four males: wing, 97–100 (99); tail, 57–58 (57.3); culmen from base, 25–25.5 (25.2); one female: wing, 100; tail, 61; culmen from base, 25 5.

Each one of the three mountains which comprise the known range of this new subspecies is isolated. Mt. Ptari-tepui lies 120 kilometers to the east of Mt. Auyan-tepui, and Mt. Guaiquinima 130 kilometers to the west. They are the northernmost extensions of the Guiana highlands in the watersheds of the Caroní and Paragua rivers.

Specimens Examined

C. b. brevicauda.—Argentina: Misiones, 2 ♂, 1 ♀, 1 (?). Brazil: Rio de Janeiro, 1 (?); São Paulo, 1 ♂, 2 ♀, 1 (?); Roca Nova, Paraná, 1 ♂, 1 ♀; "Brazil," 1 (?). Paraguay: Sapucay, 1 ♂.

C. b. olivacea.—Perú: Cushi Libertad, 1 ♂.

C. b. punctigula.—Ecuador: Río Suno, 2 ♂ (including type), 1 ♀; Sabanilla, 1 ♂; San José Abajo, 2 ♂, 1 ♀. Perú: Huarandosa, 1 ♀.

C. b. columbiana.—Colombia: Buena Vista, 1 ♂, 3 ♀.

C. b. fulvescens.—British Guiana: Merumé Mountains, 1 ♂. Venezuela (Phelps Collection): Arabupu, Roraima, 1 ♂, 1 ♀.

C. b. obscura.—Venezuela: Mt. Auyan-tepui, 1100 meters, 1 ♂ (type). Venezuela (Phelps Collection): Mt. Auyan-tepui, 1100 meters, 1 ♂; Mt. Ptari-tepui, 1500 and 1400 meters, 1 ♂, 1 ♀; Mt. Guaiquinima, 1220 meters, 1 ♂.

C. b. venezuelana.—Venezuela: Cumbre de Valencia, 1 ♂.

Pipreola whitelyi kathleenae,
new subspecies

Type: From Mt. Ptari-tepui (southwestern slope), Gran Sabana, State of Bolívar, Venezuela; altitude 1800 meters. No. 24123, Phelps Collection, Caracas. Adult female collected February 10, 1944, by Kathleen Deery Phelps. (Type on deposit at the American Museum of Natural History.)

Diagnosis: The female differs from the female of *P. w. whitelyi* in that the yellowish color of the forehead is more extensive, reaching to the middle of the crown; in having the stripes on the under parts purer black, less dusky, making a stronger contrast; and in having the breast without the tendency to olivaceous shading. The male differs from the male of *whitelyi* in having the ochraceous tint of the forehead more extensive posteriorly.

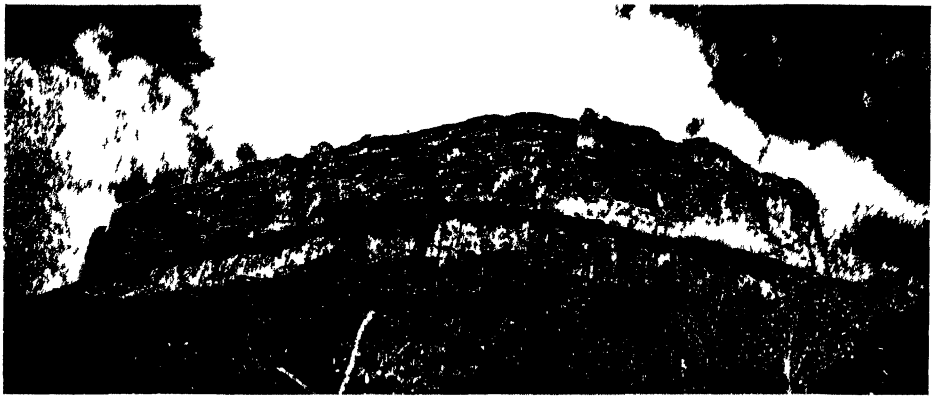


Fig 1. The cliffs of Mt. Ptari-tepui from 1650-meter camp. The altitude at the foot of the upper wall is 2100 meters. The millionth map of the American Geographical Society gives the height of the mountain as 2650 meters.

Range: Known only from the southwestern slope of Mt. Ptari-tepui, at altitudes from 1300 to 2100 meters.

Description of Type: Forehead Olive-Yellow × Olive-Ochre, merging into the dusky green of the posterior part of the crown which has ill-defined dusky centers to the feathers; back and uropygium Oil Green × Cerro Green; the color of forehead extending back in a broad superciliary stripe not quite reaching a collar on sides of neck that in turn is broken and hidden on the nape. Under parts Seafoam Green, strongest on the chin and whiter on the throat; the feathers with prominent, long, black shaft stripes, deepest on the throat and less prominent on the abdomen; under tail-coverts Citron-Yellow with dusky shaft stripes. Wing Fuscous-Black, the primaries narrowly edged with light Yellowish Olive, obsolete on the outer primary and increasing on secondaries, and entirely covering the tertials and exposed parts of upper wing-coverts; under primary-coverts grayish; rest of under wing-coverts and axillaries striped uniformly with under parts; bend of wing yellower. Tail Fuscous-Black, the two middle feathers bright Olive-Citrine as on the outer vanes of the other rectrices, shafts dark brown above, white below. Bill (in life) "orange"; feet "dirty yellow"; iris "yellow." Wing, 94 mm.; tail, 63; exposed culmen, 11.5; culmen from base, 16.5; tarsus, 22.

Remarks: Description of male (No. 24120, Phelps Collection): Forehead Xanthine Orange × Amber Brown, merging into the dusky crown near its center; this color is continuous in the lores, in a broad superciliary stripe, and tints the malar region and anterior part of auriculars; tips of auriculars gray; posterior part of crown Deep Grayish Blue-Green with dusky centers to the feathers; an Ochraceous-Orange collar on the side of neck becoming partially obsolete on the nape; back and uropygium Ivy Green. Upper throat Light Gull Gray, chin tinged with yellowish green; lower throat and upper breast Scarlet Red; sides Mars Yellow merging into the ochraceous collar; lower breast, sides, and abdomen grayish green; under tail-coverts grayish, heavily tipped with orange and orange red. Wings Fuscous-Black, the primaries, except the first, narrowly edged with Argus Brown, this increasing to cover the entire outer webs of the secondaries, tertials, and exposed parts of upper wing-coverts; under primary-coverts dark gray, rest of under wing-coverts and axillaries edged with yellowish white; bend of wing golden brown. Tail Fuscous-Black, the central rectrices and the outer edges of the others, excepting the outer ones, Argus Brown. Bill (in life) "orange-red"; feet "orange"; iris "reddish-orange." Wing, 94.5 mm.; tail, 63; exposed culmen, 11.5; culmen from base, 16; tarsus, 21.5.

Size similar to *P. w. whitelyi*. Range of measurements: nine males: wing, 90–95 (91.7) mm.; tail, 58–63 (60.2); culmen from base, 15.5–16.5 (16.2); three females: wing, 88–94 (90.7); tail, 60–63 (60.5); culmen from base, 15-16.5 (15.8).

Description of Immature Male (No. 24891, Phelps Collection): Hard skull, no pin feathers. Back and uropygium darker, less yellowish green, than the adult female, with irregularly scattered buffy spots, oval or rounded, on a dusky ground; top of head dusky black covered with buffy streaks; indications of a yellowish collar on nape; lores and ear-coverts dusky olive. Throat and upper breast whitish, with a greenish tinge, faintly streaked with dusky; lower breast, sides, and abdomen yellowish white, streaked with dusky on the margins of the feathers; under tail-coverts near Olive-Ocher. Wings Fuscous-Black; primaries and secondaries narrowly edged, and tertials and wing-coverts heavily edged with olivaceous, lighter than the back; wing-coverts with subterminal buffy spots like those on the back, forming several rows, narrowly tipped with blackish; lower wing-coverts dark gray; axillaries whitish with dusky shaft stripes. Tail like that of adult female. Maxilla (in life) "black"; mandible "black, with red base"; feet "pale orange, with brown scales"; iris "brown." Immature female similar to immature male.

Mt. Ptari-tepui is a small, very high, isolated, table-topped sandstone mountain, now explored for the first time, situated 120 kilometers to the east of Mt. Auyan-tepui. It is 2650 meters high on the millionth map of the American Geographical Society and has unscalable vertical cliffs below the summit. These are several hundred meters high. An unburnt subtropical forest reaches to the base of the cliffs at 2100 meters.

We have named this new form in honor of Kathleen Deery Phelps, collector of the type specimen, in recognition of her services to the Phelps Collection.

Specimens Examined

P. w. whitelyi.—Venezuela: Mt. Roraima (7400 feet), 1 ♂, 1 ♀. Venezuela (Phelps Collection): Mt. Roraima (7400 feet), 2 ♂, 3 ♀. British Guiana: Karamang R., 1 ♀.

P. w. kathleenae.—Venezuela (Phelps Collection): Mt. Ptari-tepui (1300–1800 meters), 9 ♂, 4 ♀ (including type), 1 ♂ juv., 1 ♀ juv., 1 (?) juv.

Acrochordopus zeledoni viridiceps,
new subspecies

Type: From Hacienda Izcaragua, Guarenas, State of Miranda, Venezuela; altitude 1100 meters. No. 18854, Phelps Collection, Caracas. Adult female collected August 6, 1942, by Ramón Urbano. (Type on deposit at the American Museum of Natural History.)

Diagnosis: Nearest to *A. z. leucogonys* of Colombia, Ecuador, and Perú but with the crown of a different color, green posteriorly with a grayish sheen merging gradually into pale gray on the forehead, instead of uniform deep gray. The back and uropygium are a lighter green, more yellowish than in *leucogonys*.

Range: Known only from the type locality.

Description of Type: Crown green with a grayish sheen which becomes light gray on the forehead and which disappears on the nape; a large white post-nasal spot narrowly crossing the base of the bill. Back and uropygium Grape Green × Deep Grape Green; tail Hair Brown × Fuscous, the rectrices narrowly edged with green, uniform with the back, and the outer three feathers narrowly tipped with whitish. Lores largely dusky; upper eyelid white; a short whitish superciliary stripe from middle of orbit to slightly beyond its posterior border; a dusky postocular streak; malar region black with white tips to the feathers; auriculars grayish white. Chin white; throat, breast, and sides Chartreuse Yellow with slightly dusky centers to the feathers; abdomen and bend of wing Citron Yellow; under tail-coverts paler; under aspect of tail Light Grayish Olive. Wings Fuscous-Black, the primaries, except the first, narrowly edged with green uniform with the back; secondaries, tertials, and upper wing-coverts broadly edged with yellow, duller than the abdomen; under wing-coverts and axillaries yellowish white; inner margin of remiges dull yellowish, withdrawn basad on outer feathers. Tarsus with roughened envelope as in the conspecies. Maxilla (in life) "black"; mandible "flesh"; feet "black"; iris "sepia." Wing, 59 mm.; tail, 42; exposed culmen, 8; culmen from base, 11.5; tarsus, 14.

REMARKS: Size similar to *leucogonys*. Measurements of *leucogonys:* one female, Zamora, Ecuador, wing, 56 mm.; tail, 42; culmen from base, 11.4; four Colombian skins without sex: wing, 59–62 (60); tail, 36–40 (38.2); culmen from base, 10.5–11 (10.9).

The species has not been recorded nearer to the Caracas region than Bogotá and Buena Vista in Colombia. It must be extremely rare not to have been collected before, since it was taken only about 10 miles east of Caracas on the southern slope of the coast range.

SPECIMENS EXAMINED

A. z. zeledoni.—COSTA RICA: Aquinares, 1 ♂. PANAMA: Chiriquí, Boquete, 1 ♂.

A. z. leucogonys.—COLOMBIA: Buena Vista, 1 (?); "Bogotá," 3 (?). ECUADOR: Zamora, 1 ♀.

A. z. viridiceps.—VENEZUELA (Phelps Collection): Hacienda Izcaragua, Guarenas, 1 ♀. (type).

Cyanocorax violaceus pallidus,
new subspecies

TYPE: From Barcelona, State of Anzoátegui, Venezuela; altitude 100 meters. No. 14995, Phelps Collection, Caracas. Adult male collected October 29, 1941, by Fulvio Benedetti. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Paler throughout than the nominate race, especially below.

RANGE: Known only from the Caribbean coast of the State of Anzoátegui at Barcelona and Píritu, Venezuela.

DESCRIPTION OF TYPE: Head and throat black; a narrow white nuchal collar; back and rump Dark Plumbago Gray paler towards the collar; upper aspect of remiges, upper wing-coverts, under wing-coverts, and upper surface of rectrices Windsor Blue × Deep Dull Bluish Violet; breast, flanks, abdomen, and axillaries Pale Violet-Gray, the under tail-coverts and shanks darker; under aspect of remiges and rectrices Sooty Black. Bill (in life)"black"; feet "black"; iris "dark." Wing, 187 mm.; tail, 160; exposed culmen, 32; culmen from base, 41.2; tarsus, 47.2.

REMARKS.—Size similar to *C. v. violaceus*. The three males of the new race measure: wing, 187, 188, 189 mm.; tail, 160, 166, 160; exposed culmen, 32, 30, 35; culmen from base, 41.2, 41, 39; tarsus, 47.2, 46.6, 50.

The populations along the Orinoco River and in the upper Apure region are lighter colored than those of Perú, Ecuador, and Colombia, but they are closer to *violaceus* than to the new form.

These specimens extend the range of the species to the Caribbean coast from the Orinoco River. As the species has never been collected in the mountainous regions of northeastern Venezuela or of Caracas, the range of the new form may be confined to the low coastal country which separates the Caracas mountainous region from that of the interior of Cumaná, where little collecting has been done.

SPECIMENS EXAMINED

C. v. violaceus.—PERÚ: Prov. Huánuco, 1 ♀; Pisana, 1 (?); Lupuna, 1 (?); "Peru," 1 (?); Boca Río Curaráy, 3 ♂, 3 ♀. ECUADOR: Río Suno, 2 ♂, 3 ♀; San José Abajo, 5 ♀; Zamora, 1 ♂, 1 ♀; Río Napo, 3 (?). COLOMBIA: La Morelia, 1 ♂, 3 ♀; Buena Vista, 1 ♂; Villavicencio, 1 ♂, 1 ♀, 1 (?); Barrigon, 1 ♂, 1 ♀; "Bogotá," 4 (?); "Colombia," 1 (?). BRAZIL: Río Jurúa, Amazonas, 1 ♂. VENEZUELA: Ciudad Bolívar, 2 ♀; Río Mato, 3 ♂, 2 ♀; Caicara, 4 ♂, 3 ♀; Boca de Sina, 1 ♂, 1 ♀; foot of Mt. Duida, 3 ♂. VENEZUELA (Phelps Collection): San Félix, 1 ♀; Ciudad Bolívar, 3 ♂; Santa Rosalía, lower Caura, 1 ♂, 1 (?); Caño Guaniamo, Río Cuchivero, 2 ♂, 1 (?); Guanare, 1 ♂; Barinas, 1 ♀; Ciudad Bolivia, Barinas, 1 ♂; Santa Bárbara, Barinas, 1 ♂; Santo Domingo, 1 ♂, 4 ♀; Sanariapo, 1 ♂, 1 ♀; Caño Cataniapo, 2 (?).

C. v. pallidus.—VENEZUELA (Phelps Collection): Barcelona, 2 ♂ (including type); Píritu, 1 ♂.

Henicorhina leucophrys tamae,
new subspecies

TYPE: From Páramo de Tamá Camp, State of Táchira, Venezuela; altitude 2540 meters. No. 10904, Phelps Collection, Caracas. Adult male collected February 11, 1941, by Ventura Barnés, Jr. (Type on deposit at the American Museum of Natural History.)

DIAGNOSIS: Nearest to *H. l. meridana*, of the Mérida region, but flanks, lower abdomen, and under tail-coverts paler, more yellowish brown, and the back averaging lighter brown. Differs from *H. l. leucophrys*, of Colombia, Ecuador, and Perú, in having the throat streaked with blackish, and the flanks, abdomen, and under tail-coverts paler, more yellowish brown.

RANGE: Páramo de Tamá (both in Venezuela and in Colombia) and its approaches from the north, in the upper Subtropical Zone at altitudes from 2300 to 3000 meters; probably also on the eastern slopes of the Eastern Andes of Colombia.

DESCRIPTION OF TYPE: Crown medially Light Brownish Olive, more dusky on forehead, the feathers inconspicuously edged with dusky giving a scalloped appearance; sides of crown with a broad black stripe reaching to the nape; back and uropygium Argus Brown; prominent superciliary stripe from the nostrils to the sides of the mantle; lores, upper ear-coverts, and wide postocular stripe black; lower eyelid white; malar region, lower auriculars, and sides of neck white streaked with black margins to the feathers. Chin narrowly white; throat white, finely streaked with black on the margins of feathers; breast and center of upper abdomen pale neutral gray, darker on the sides; lower belly strongly washed with Cinnamon-Buff; upper flanks, sides of abdomen, and under tail-coverts Clay Color; lower flanks bright Cinnamon-Brown. Wings Chaetura Drab, the three outer remiges narrowly edged with grayish, the outer vanes of other remiges narrowly barred with Sayal Brown; tertials more rufescent, barred across both webs; the outer margins of upper wing-coverts Amber Brown × Argus Brown; bend of wing whitish, axillaries and under wing-coverts grayish. Tail warm brown, narrowly barred with blackish. Bill (in life) "black"; feet "brown"; iris "brown." Wing, 56 mm.; tail, 29; exposed culmen, 15; culmen from base, 17; tarsus, 24.

REMARKS: Sexes alike. Size similar to *H. l. meridana*. Range of measurements: eight males: wing, 54–57 (55.5) mm.; tail, 25–31(27.2); culmen from base, 16.5–18.5 (17.5); seven females: wing, 51–54 (52.7); tail, 23–25 (24.4); culmen from base, 15.5–17 (16.5).

Hellmayr, in "Birds of the Americas" (1934, Publ. Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 7, p. 266), examined five specimens from Páramo de Tamá, three from Río Negro, Boyacá, Colombia, and two from "Bogotá." He listed them all as *H. l. meridana* of the Mérida region, saying: "Birds from Páramo de Tamá, Santander, and Río Negro, Boyacá, form the transition to *H. l. leucophrys*, but are nearer to the Mérida form." Our series in the Phelps Collection of 16 specimens from the Tamá region, and 22 from the Mérida region, all recently collected, shows them to be quite distinct.

In the American Museum of Natural History there is a specimen from Buena Vista, above Villavicencio, Colombia, which has the back as light as any of the topotypes of *tamae* and the streaks on the throat similar to those of *tamae* and *merid-*

ana. Chapman, in "Distribution of bird life in Colombia" (1917, Bull. Amer. Mus. Nat. Hist., vol. 36, p. 525), found this bird different from the large series of "*guttata*" [=*leucophrys*] in the Museum from the rest of Colombia. This specimen, as well as those from Boyacá and "Bogotá" cited above by Hellmayr, would indicate that the range of the new form may extend along the eastern slopes of the Eastern Andes of Colombia.

Specimens Examined

H. l. boliviana.—Bolivia: 7.

H. l. leucophrys.—Perú: 11. Ecuador: 49. Colombia: Cerro Munchique, Cauca, 2 ♂, 3 ♀ 2 (?); Salento, Cauca, 2 ♂, 1 ♀; San Antonio Cauca, 7 ♂, 1 ♀, 1 (?); Palmira, Cauca, 4 ♂ 2 ♀; El Toche, Tolima, 3 ♂, 2 ♀; El Eden 1 ♀; El Roble, 2 ♂; Chipaque, 1 ♀; La Candela, Huila, 4 ♂, 2 ♀; Subia, Cundinamarca, 3 ♂; Las Cruces, 1 ♂; Aguadita, 4 ♂; Fusugasugá, 1 ♂, 1 ♀; "Bogotá," 6 (?); La Frijolera, Antioquia, 1 ♂, 1 ♀.

H. l. hilaris.—Ecuador: 43.

H. l. brunneiceps.—Colombia: Cocal, Cauca, 2 ♂; Nóvita Trail, Cauca, 1 ♂, 1 ♀; Galera, Cauca, 1 ♂. Ecuador: Peramba, 1 ♀.

H. l. tamae.—Venezuela (Phelps Collection): Páramo de Tamá Camp, 7 ♂ (including type), 3 ♀; Villa Paéz, Páramo de Tamá, 1 ♂, 1 (?); Las Delicias, Páramo de Tamá, 1 ♂, 4 ♀. Colombia: Buena Vista, above Villavicencio, 1 ♂.

H. l. meridana.—Venezuela: La Culata Mérida, 2 ♂, 1 ♀; Duraznos, 1 ♀; Tambor, 1 ♂; El Valle, 1 ♂, 1 (?); "Mérida," 1 (?). Venezuela (Phelps Collection): Queniquea, Táchira, 2 ♂, 1 (?); Boca de Monte, Pregonero, 2 ♂, 1 ♀, 2 (?); Quintero, Mérida, 1 ♂, 2 ♀; Llano Rucio, 1 ♂; La Culata, 1 ♀; Páramo San Antonio, 1 ♀; El Valle, 1 ♂, 1 ♀, 1 (?); El Rincón, Cerro Niquitaz, Trujillo, 3 ♂, 1 ♀; Cendé, Páramo Cendé, 1 ♂.

H. l. venezuelensis.—Venezuela: Mt. Bucarito, Lara, 1 (?); Cumbre de Valencia, 1 ♂, 1 ♀; Limón, Puerto la Cruz, 1 ♂, 1 ♀; Galipán, 1 ♂, 1 ♀; Cerro del Avila, 1 ♀. Venezuela (Phelps Collection): Junquito, 2 ♂; Colonia Tovar, 3 ♂, 1 ♀, 3 (?); San José de Los Caracas, 1 ♂; Hacienda Izcaragua, Guarenas, 2 ♂, 1 ♀; Cerro Golfo Triste, San Casimiro, 3 ♂, 3 ♀, 4 (?); Colonia Chirgua, 1 ♂; Hacienda Santa Clara, Carabobo, 2 ♂, 2 ♀.

H. l. bangsi.—Colombia: Santa Marta, 15.

H. l. collina.—Panamá and Costa Rica: 27.

H. l. castanea.—Guatemala: Finca Sepacuite, 4 ♂, 1 ♀.

H. l. capitalis.—Guatemala: San Lucas, 2 ♂.

H. l. mexicana.—México: Veracruz, 2 ♂, 1 ♀.

Dendroica petechia cienagae,

new subspecies

Type: From La Ciénaga, between Ocumare de la Costa and Turiamo, State of Aragua, Venezuela; sea level. No. 20445, Phelps Collection, Caracas. Adult male collected March 8, 1943, by William H. Phelps, Jr. (Type on deposit at the American Museum of Natural History.)

Diagnosis: Similar to *D. p. rufopileata* of Curaçao, the Venezuelan islands, and the mainland of the Cumaná and Barcelona regions, but the stripes, in the male, extend over the throat and chin instead of being confined to the breast. The stripes on the chin suggest *peruviana*, but the crown of that form is distinctly lighter. The female differs from *rufopileata* in having the upper parts darker, more olivaceous, less yellowish, and by having a faint rufous tinge to the crown as in *peruviana*.

Range: Known only from the type locality.

Description of Type: Forehead and crown Auburn × Chestnut; hind neck, back, and upper tail-coverts Yellowish Citrine × Strontian Yellow with the center of the feathers faintly dusky; rump more yellowish. Lores and superciliary stripe Lemon Chrome; cheeks merging into the color of the back; chin, throat, breast, and flanks Lemon Chrome broadly striped with light Auburn, the lower abdomen and under tail-coverts remaining virtually unstriped. Wings brownish black, the remiges narrowly edged with the color of the back, and the tertials and upper wing-coverts broadly edged with Lemon Yellow, deeper on the greater coverts; basal half of inner margin of first primary Lemon Yellow, the extent of this increasing gradually through the secondaries; axillaries and under wing-coverts Lemon Chrome. Tail brownish black, the rectrices thinly edged on the outer vanes with Olive-Yellow, but the inner vanes are Lemon Chrome with dusky tips, the yellow part decreasing until there is none on the central rectrices. Maxilla (in life) "dark olive"; mandible "gray"; feet "yellowish-brown." Wing, 66 mm.; tail, 51; exposed culmen, 10.5; culmen from base, 14.2; tarsus, 20.

Remarks: Description of female (No.

20444, Phelps Collection): above darker than the male, dark Yellowish Citrine with more or less hidden dusky centers to the feathers; forehead and crown with a faint rufous tinge; wings and tail brownish black with edgings of rectrices and remiges uniform with the back; edgings of wing-coverts more yellowish; lores, eye-ring, auriculars, under parts, a large patch on inner margin of inner vane of three outermost rectrices, under wing-coverts, and inner margins of remiges Lemon Chrome. Size smaller than the male.

Range of measurements: six males: wing, 62–66 (63.5); tail, 46–51 (47.5); culmen from base (three specimens), 13–14.2 (13.6).

The locality where all the specimens were collected is a mangrove swamp on the western shore of the uninhabited bay of La Ciénaga, midway between the small ports of Ocumare de la Costa and Turiamo. This same swamp produced the unique type of *Rallus wetmorei*.

The range of *rufopileata* has now been extended to the mainland of Venezuela by a series in the Phelps Collection from the vicinity of Guanta and Cumaná.

Specimens Examined

D. p. coa.—Jamaica and Grand Cayman Island: 34.

D. p. gundlachi.—Cuba: 2 ♂, 1 (?).

D. p. albicollis.—Santo Domingo: 3 ♂.

D. p. solaris. Haiti: 1 ♂, 1 ♀.

D. p. flaviceps. –Bahamas: 8.

D. p. cruciana. Puerto Rico: 21.

D. p. bartholemica. -Antigua, San Martin, and St. Thomas: 1 ♂, 9 ♀.

D. p. melanoptera. Guadaloupe and Dominica: 11 ♂, 11 ♀, 3 (?).

D. p. ruficapilla. Martinique: 4 ♂, 1 ♀.

D. p. babad. Santa Lucia: 1 ♂.

D. p. alsiosa. Grenadines: 5 ♂, 3 ♀.

D. p. petechia. Barbados: 6 ♂, 4 ♀, 1 (?).

D. p. rufopileata.—Curaçao: 12 ♂, 6 ♀. Aruba: 1 ♂, 2 ♀. Bonaire: 1 ♂. Venezuela: Testigos I., 4 ♂, 5 ♀; Blanquilla I., 4 ♂, 4 ♀; Los Roques I., 2 ♂. Venezuela (Phelps Collection): Tortuga I., 1 ♂; Bahía de Guanta, 2 ♂; Isla de Cachicamo, Bahía de Guanta, 4 ♂; Puerto La Cruz, Anzoátegui, 2 ♂, 1 [♂]; Cumaná, 1 ♂.

D. p. cienagae.—Venezuela (Phelps Collection): La Ciénaga, Aragua, 2 ♂ (including type), 4 [♂], 3 ♀, 1 [♀].

D. p. paraguanae.—Venezuela· Paraguaná Peninsula, 1 ♂, 1 ♀; La Boca, Adícora, Paraguaná Peninsula, 2 ♂, 4 ♀.

D. p. erithachorides.—Venezuela (Phelps Collection): Paraguaipoa, Goajira Peninsula, 3 ♂, 2 ♀; Castilletes, Goajira Peninsula, 1 ♂, 1 ♀.

D. p. peruviana.—Colombia and Ecuador: 22.

D. p. aureola.—Galápagos Islands: 2 ♂.

D. p. aequatorialis.—Panamá: 9 ♂, 7 ♀, 2 (?).

D. p. xanthotera.—Guatemala: 3 ♂, 2 ♀.

D. p. bryanti.—México, British Honduras, Nicaragua, and Costa Rica: 40.

D. p. rufivertex.—México: Cozumel I., 10.

D. p. castaneiceps.—Lower California: 13.

Diglossa major disjuncta, new subspecies

Type: From Mt. Ptari-tepui, southwestern slope, Gran Sabana, State of Bolívar, Venezuela, altitude 1650 meters. No. 24177, Phelps Collection, Caracas. Adult male collected February 16, 1944, by William H. Phelps, Jr. (Type on deposit at the American Museum of Natural History.)

Diagnosis: Nearest to *D. m. major*, of Mt. Roraima, from which it differs in being more strongly bluish below, less grayish and with the crissum more deeply rufescent. Differs from *D. m. gilliardi*, of Mt. Auyantepui, by being lighter below, less deeply bluish, with the pale shaft-streaks less pronounced and confined to the breast instead of extending over the abdomen; black of chin less extensive as in *major*.

Range: Known only from Mt. Ptari-tepui in the Subtropical Zone, at altitudes between 1350 and 2100 meters.

Description of Type: Crown and forehead except for a narrow black frontal band, Clear Payne's Gray; nape, back, and uropygium dusky with a bluish tint with fine Light Payne's Gray shaft-stripes, broader on the nape and sharper on the mantle; lores, a narrow eye-ring, malar region, auriculars, and chin black, with a slight whitish malar stripe. Throat Gull Gray, the feathers slightly edged with bluish dusky; breast, sides, and abdomen slate gray with fine inconspicuous shaft-streaks on the breast, Pale Payne's Gray; under tail-coverts Auburn × Sanford's Brown. Wings Fuscous-Black, the primaries, except the first, and the outer secondaries narrowly edged with bluish gray except towards the tips; median and lesser upper wing-coverts streaked, uniform with the back; greater series largely blackish, with short, pale streaks at the tips; under wing-coverts and axillaries grayish. Tail black above, Dark Mouse Gray below, with the outer vanes of rectrices narrowly edged with Deep Payne's Gray, almost obsolete on the outermost pair; tips of the rectrices inconspicuously pale with a brief whitish shaft-streak. Bill (in life) "pale blue, black tip"; feet "black"; iris "dark." Wing, 84 mm.; tail, 77; exposed culmen, 15; culmen from base, 20; tarsus, 26.

REMARKS: Sexes alike. Size similar to that of the other subspecies. Range of measurements: six males: wing, 79–85 (81.3) mm.; tail, 72–77 (74.5); culmen from base, 19–20 (19.7); five females: wing, 77–80 (78.2); tail, 69–72 (70.2); culmen from base, 19–21 (19.7).

It is interesting that each one of the four mountains south of the Orinoco River that have been explored in the Subtropical Zone has produced a different subspecies of *Diglossa major*, or a separate species of the genus: Mt. Roraima, *D. m. major;* Mt. Auyan-tepui, *D. m. gilliardi;* Mt. Ptari-tepui, *D. m. disjuncta;* and Mt. Duida, *D. duidae*. These are all isolated, sandstone, table-topped mountains with their summits defended by vertical cliffs several hundred meters high.

SPECIMENS EXAMINED

D. m. major.—VENEZUELA: Mt. Roraima, 13 ♂, 10 ♀.

D. m. gilliardi.—VENEZUELA: Mt. Auyan-tepui, 16 ♂, 19 ♀, 2 (?).

D. m. disjuncta.—VENEZUELA (Phelps Collection): Mt. Ptari-tepui, 6 ♂ (including type), 5 ♀.

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NEW PSEUDOSCORPIONS OF THE SUBFAMILY LAMPROCHERNETINAE

BY C. CLAYTON HOFF[1]

Through the kindness of Dr. W. J. Gertsch, the writer has been privileged to study the pseudoscorpions in the collection of the American Museum of Natural History. In the present paper five new species belonging to the subfamily Lamprochernetinae are described from Mexico, Central America, and Dominica. New records for a sixth species of the subfamily are given. Other species, possibly new, of this subfamily were found in the collections examined, but in each instance the material was considered inadequate for description.

Measurements given in the text are, unless otherwise indicated, of specimens cleared in beechwood creosote and mounted in Canada balsam. The body, but not the appendages, of each individual was treated before mounting with potassium hydroxide solution. All drawings were made with the aid of a camera lucida.

Type specimens are deposited in the American Museum of Natural History.

SUBORDER MONOSPHYRONIDA CHAMBERLIN

SUPERFAMILY **CHELIFEROIDEA** CHAMBERLIN

FAMILY **CHERNETIDAE** CHAMBERLIN

Subfamily **Lamprochernetinae** Beier

Lamprochernes ellipticus, new species

Figures 1–4

FEMALE: Body elongate, elliptical, length 3.5 mm. Cephalothorax with straight posterior margin and rounded anterior margin; marked median furrow near center, posterior furrow weak; color brown anteriorly, yellow posteriorly; slightly granular on the sides anterior to the median furrow; length 0.93 mm.; width 0.77 mm.; eight or 10 long, acuminate setae along the posterior margin; face sparsely setaceous. Abdomen yellowish brown, 2.6 mm. in length, 1.25 mm. in width. Tergites divided, except the first incompletely, the last not at all; 16 to 18 acuminate setae on each entire tergite from the first through the tenth; chaetotaxy of each tergite consisting of a marginal row, a single seta placed anteriorly and medially in each half tergite, and a seta placed anteriorly and laterally in each half tergite. Sternites except the last divided; usually 20 to 24 setae on the fifth to tenth sternite; position of setae as on the tergites; all setae acuminate; fourth sternite with six medially placed setae. Posterior stigmatic plate with one seta, the anterior with three. Pleural membranes marked by large numbers of closely placed longitudinal plications.

Chelicera: Width of base 0.175 mm.; basal and subbasal setae much shorter than interior and laminal setae; flagellum of three setae, the two distal ones subequal in length and much longer than the proximal; the distal seta of the flagellum toothed along the anterior margin. Fixed finger with lamina exterior; serrula interior with the five distal teeth separate, ligulate, and marginally serrate; outer margin of fixed finger with a shallow subterminal sinuation; terminal tooth with two rounded cusps on the inner surface; internal margin of finger distal to terminal

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[1] Quincy College, Quincy, Illinois. This study was aided by a grant from the American Association for the Advancement of Science through the Illinois State Academy of Science.

tooth with four well-developed denticles. Movable finger with straight margins; slightly and evenly narrowed distally; length 0.23 mm.; serrula exterior with 19 to 21 ligulate plates, the proximal one longer than the others; internal margin edentate except for the single subapical lobe just distal to the base of the galeal seta; terminal tooth roughened on the concave side; galea with six thorn-like, terminal and lateral, undivided branches.

Palp: Robust, stout, reddish brown in color, granular in part; many of the long, acuminate setae with minute subterminal dentations. Maxilla 0.495 mm. long, 0.29 mm. wide. Trochanter, about 0.4 mm. in length; granular; with two sublateral protuberances, the more dorsal one being somewhat anterior to the subventrally placed protuberance. Femur stout, tumid; medially granular, laterally nearly smooth; length 2.25 times the width; length 0.73 mm., width 0.325 mm.; but little longer than tibia. Tibia 1.9 times as long as wide; lateral margin markedly curved near the distal one-third; medial margin evenly convex; a few granulations on the anterior-mesial surface. Chela 1.28 mm. long; 0.48 mm. wide; 2.65 times as long as wide; slightly granular on the anterior-mesial surface of the hand, otherwise seemingly smooth; hand with length of 0.675 mm., depth of 0.48 mm.; movable finger only with venom duct and tooth; nodus ramosus proximal to tactile seta *t;* movable finger 0.6 mm. in length. Fixed finger with eight sensory setae arranged in two groups as follows: *eb* and *esb* near base of finger and two to three areole diameters apart, *et* terminal and less than one-sixth of finger length from tip, *est* nearly midway between *et* and *eb; ib* and *isb* at level of *esb* and *eb, ist* nearly on level with *est,* distance between *ist* and *isb* less than distance of *t* from end point of finger. Movable finger with four tactile setae: *t* about one-third of finger length from tip; *b* and *sb* not far removed from base of finger and separated by less than two areole diameters; *st* about equidistant from *t* and *b*, being closer to *sb* than to *t*. Marginal and accessory teeth developed in both fingers. Fixed finger with a marginal row of between 35 and 40 teeth arranged contiguously along all but a small distal portion of the margin; the marginal teeth near the rounded finger tip enlarged; two internal accessory teeth, subterminally placed; external accessory teeth 12 in number, triangular in shape, well separated and evenly spaced through about the distal two-thirds of the finger length. Movable finger with teeth of marginal row similar in shape, position, and number to those of the opposing finger; a single internal accessory tooth removed from the finger tip by almost one-fourth of the finger length; external row of nine accessory teeth well spaced along the distal one-half of the finger.

Legs: Fairly stout; setae long and acuminate; subterminal setae simple; terminal claws hook-shaped, simple. First leg with trochanter 0.15 mm. deep; entire femur 0.53 mm. long, 0.17 mm. deep; tibia with greatest depth at about the distal one-third, length 0.415 mm., depth 0.105 mm.; tarsus with sides straight, slightly narrowed distally, 0.35 mm. long, 0.07 mm. deep. Fourth leg with trochanter 0.31 mm. long and 0.185 mm. deep; pars basilis of femur 0.27 mm. long, 0.21 mm. deep; pars tibialis 0.575 mm. long, 0.25 mm. deep; entire femur with well-rounded extensor margin, flexor margin slightly convex and conspicuously beset with acuminate setae; length of entire femur 0.75 mm., depth 0.25 mm., length 3 times the depth; tibia with length of 0.595 mm., depth of 0.145 mm., length 4.1 times the depth; tarsus of nearly equal width throughout, length 0.415 mm., depth 0.095 mm., length 4.4 times the depth; tactile seta of extensor margin of tarsus 0.08 mm. from the proximal-extensor corner of the podomere.

Genital complex: Posterior operculum with 10 to 12 marginal setae; anterior operculum with three setae well spaced laterally on each side of a small, compact group of 11 medially placed setae.

TYPE LOCALITY: The single female holotype upon which this description is based belongs to a collection labeled "Algodones, Baja Calif., Mexico, Mar. 6, 1937, Cockerell, etc. Coll."

The only previously described Nearctic

species of this genus is the widely distributed North American species, *Lamprochernes oblongus* (Say), which differs from *L. ellipticus* in many characteristics including body size and the shape of the palpal podomeres.

Lustrochernes communis (Balzan)

Chelifer communis BALZAN, 1890, Ann. Mus. Civ. Storia Nat. Genova, ser. 2, vol. 9, p. 416, pl. 13, fig. 4.

Lustrochernes communis BEIER, 1932, Das Tierreich, vol. 58, pp. 90–91, fig. 110.

RECORDS: La Zacualpa, Chiapas, Mexico; La Buena Ventura, Veracruz, Mexico.

Lustrochernes dominicus, new species

Figures 5–7

MALE: Elongate, elliptical; yellowish brown in color; 2.9–3.5 mm. long. Cephalothorax about 20 per cent longer than wide; length 0.85–1 mm.; surface smooth; medial transverse furrow somewhat more pronounced than the posterior; anterior margin rounded; posterior margin straight and with a row of 10 to 12 acuminate setae; scattered setae on face and sides; eye spots not observed (KOH treated material). Abdomen elongate, 1.75–2.5 mm. long; 0.95–1.15 mm. wide; yellowish brown color. Tergites divided except the first incompletely divided or entire, the last never divided; chaetotaxy of each half tergite consisting of a single medial-anterior seta, one or two lateral setae, and a marginal row of six or seven setae; total number of setae for each entire tergite from one to 10 inclusive ranging from 16 to 22. Sternites from four to 10 inclusive divided; chaetotaxy of fifth to tenth sternites similar to that of the tergites except additional setae in the marginal row, total setae for each sternite varying from 20 to 26; fourth sternite with six to eight setae; all setae acuminate. Pleural membranes with numerous longitudinal, somewhat irregular plications. Anterior and posterior stigmatic plates with three setae.

Chelicera: Width of base 0.175 mm.; subbasal and basal setae shorter than laminal and interior setae; all setae acuminate; flagellum of three setae, the anterior one serrate along the distal edge. Fixed finger with three denticles along the concave margin of the terminal tooth; five teeth (sometimes a rudimentary sixth) along the inner margin of the finger; lamina exterior present; serrula interior with basal teeth fused to form a velum and with five distal teeth marginally serrate and free. Movable finger 0.24–0.275 mm. long; serrula exterior of 20 to 23 ligulate plates, basal two longer than the rest; galea variable, bifurcated proximal to the midpoint, the lateral ramus smaller than the other, both rami usually subdivided; subapical lobe strong; slight protuberance on the inner margin of the finger near the level of the galeal seta.

Palp: Stout; somewhat shorter than body; color reddish brown. Maxilla lighter in color than rest of palp; 0.48–0.53 mm. long, 0.27–0.32 mm. wide. Trochanter with few setae; two or sometimes three sublateral protuberances; granular at least laterally; averaging about 0.4 mm. in length, 0.3 mm. in width. Femur with mesial margin granular; centrally tumid; medial margin with a marked concavity in the distal half; length 0.8–0.85 mm.; width 0.34–0.37 mm.; length 2.2–2.4 times the width. Tibia with mesial-distal surface granular; lateral margin with a marked convexity at each end; length 0.72–0.77 mm.; width 0.37–0.41 mm.; length 1.85 to 1.95 times the width. Chela 1.3–1.4 mm. long; 0.5–0.55 mm. wide; 2.5 to 2.7 times as long as wide; hand length 0.675–0.765 mm.; hand depth 0.51–0.55 mm.; depth equal to width; chela virtually smooth; setae long, acuminate, numerous; length of movable finger 0.62–0.68 mm., slightly less than hand length; movable finger only with poison apparatus and tooth. Movable finger with about 40 small, contiguous teeth, arranged along the distal four-fifths of the finger length; nine to 11 or more external accessory teeth well spaced within the distal two-thirds of the finger length; internal accessory teeth four or five in number, conical, close together and some distance removed from the finger tip. Fixed finger with more than 40 marginal teeth, the distal ones more acute, especially near the rounded finger tip; usually 10 to 11 external accessory teeth well spaced along the distal four-fifths of the finger length; five or six internal accessory teeth along the distal one-third of the finger; teeth of all rows variable in number and position. Four tactile setae on movable finger: *t* about one-third of finger length from tip; *b* and *sb* close to base, separated by little more than one areole diameter; distance of *st* from *t* usually less than the distance of *t* from the finger tip; *st* usually slightly closer to *b* than to *t;* nodus ramosus slightly proximal to *t.* Fixed finger with two series of sensory setae: external series with *et* one-sixth of finger length from tip, *eb* and *esb* near base and separated by about two areole diameters, *est* variable in position but usually about as far from *et* as from *eb* and *esb;* internal series with *it* about one-third of finger length from tip, *ist* often about one-half as far from *it* as *it* is from finger tip, *ist* on level with *est,* usually about twice as far removed from *ib* and *isb* as from *it, isb* and *ib* near base of finger separated by about two areole diameters. *Position of tactile setae extremely variable,* restricting their usefulness in species diagnosis.

Legs: Moderately stout, yellow color; claws simple. First leg with trochanter length equal to depth; entire femur 0.52–0.6 mm. in length, 0.19–0.24 mm. in depth, length 2.5 to 2.7 times the depth; tibia with extensor margin weakly S-shaped, greatest depth near distal one-fourth, length 0.39–0.43 mm., depth 0.12–0.135 mm., length 3.2 to 3.3 times the depth; tarsus 0.35 mm. long, 0.085–0.09 mm. deep, length 3.9 to 4.1 times the depth. Fourth leg with trochanter length 0.3–0.32 mm., depth two-thirds of length; pars basilis of femur 0.32 mm. long, 0.24–0.26 mm. deep; pars tibialis 0.63–0.675 mm. long, 0.28–0.31 mm. deep; entire femur 0.8–0.82 mm. long, 0.28–0.305 mm. deep, flexor margin little convex, extensor margin evenly arched; entire femur 2.7 to 2.85 times as long as deep; tibia 0.59–0.635 mm. long, 0.16–0.18 mm. deep, 3.5 to 3.7 times as long as deep, deepest near the distal third; tarsus 0.415–0.435 mm. long, 0.11–0.115 mm. deep, 3.65 to 3.8 times as long as deep, slightly narrowed distally; tactile seta 0.09–0.1 mm. from basal-extensor corner of the podomere.

Genital complex: Posterior operculum with three variable setae groups: a row of about 10 long and acuminate setae along the posterior margin, a row of four or six slightly shorter setae just anterior to the first row, and a row of four short setae anterior to the others and immediately posterior to the genital opening. Anterior operculum with eight setae in a row immediately anterior to the genital pore and about 16 scattered setae anterior to the row.

FEMALE: Average length 3.8 mm.; color and shape as in the male. Cephalothorax like that of the male; abdomen often longer than in male; tergites and sternites similar in the two sexes.

Chelicera: As in the male.

Palp: In general similar to the palp of the male. Femur length 0.8–0.9 mm.; width 0.35–0.38 mm.; length 2.25 to 2.4 times the width. Tibia 0.69–0.77 mm. in length; width 0.4–0.41 mm.; length 1.75 to 1.9 times the width. Chela length 1.375–1.45 mm., width 0.55–0.59 mm., length 2.4 to 2.5 times the width; hand length 0.8 0.82 mm.; hand depth 0.54–0.57 mm.; length of finger 0.64–0.655 mm. Teeth and tactile setae of fixed and movable fingers as in the male.

Legs: Similar to male except podomeres sometimes slightly longer. First leg with femur up to 2.9 times as long as deep; tibia 0.42 0.46 mm. long, 0.13 0.135 mm. deep, 3.25 to 3.4 times as long as deep; tarsus as in the male. Fourth leg with pars basilis often slightly longer and deeper than in the male; pars tibialis 0.65-0.7 mm. long, 0.3-0.315 mm. deep; entire femur 0.83 0.89 mm. long, 0.3 0.315 mm. deep, 2.7 to 2.9 times as long as deep; tibia 0.625–0.655 mm. long, 0.17-0.175 mm. deep, 3.7 times as long as deep; tarsus 0.43–0.45 mm. long, 0.115–0.12 mm. deep, 3.65 to 3.75 times as long as deep; tactile seta 0.11–0.115 mm. from proximal-extensor corner of tarsus.

Genital complex: Posterior operculum with a single row of 10 to 14 setae; anterior operculum with a group of three or four setae anteriorly placed on each side of the opening and a medially placed compact group of 14 to 18 setae.

TYPE LOCALITY: Male holotype and three male paratypes from Fore Hunt Flat, Dominica, collected on June 27, 1911; female allotype and five paratypes including both sexes from Laudet, Dominica, June 12, 1911.

Cordylochernes angustochelatus,
new species

Figure 8

MALE: Body 3.5 mm. long; stout; color yellowish brown. Cephalothorax 1.27 mm. long, 1.12 mm. wide; marked median transverse furrow just posterior to midpoint of cephalothorax; conspicuous posterior furrow about midway between median furrow and posterior margin; surface weakly granular anterior to median furrow, especially on the lateral surface; smooth, more setaceous, and lighter in color posterior to median furrow; anterior margin rounded; posterior margin slightly convex with 12 to 14 marginal setae. Abdomen fairly stout, 2.25 mm. long, width about two-thirds of length. Tergites except the first and eleventh divided; chaetotaxy consisting in each half tergite of a medial-anterior seta, a row of marginal setae, and one or two lateral setae; total setae for each tergite varying from about 18 to 24; all setae acuminate. Sternites from four to 10 inclusive divided; chaetotaxy of fifth to tenth half sternites similar to the half tergites except additional setae in marginal row; total setae for center sternites about 28. Fourth sternite with 10 setae. Pleural membranes marked by numerous fairly regular plications. Each anterior stigmatic plate with six setae, the posterior with three.

Chelicera: Width of base 0.23 mm.; basal and subbasal setae shorter than laminal and interior setae; flagellum of three setae, the anterior one bearing six to eight acute serrations along the distal margin; all setae of base acuminate. Fixed finger with lamina exterior; serrula interior with the six distal teeth serrate, ligulate, and free; other teeth of serrula interior fused into a velum; apical tooth with three denticles along the concave margin; six teeth along the interior margin of the finger. Movable finger about 0.35 mm. in length; interior and exterior margins almost straight; serrula exterior with 26 or 27 ligulate teeth, proximal two longer than the remainder; apical tooth heavy; well-developed subapical lobe somewhat distal to the galeal seta; galea proximally bifurcated, both rami branched.

Palp: In general more slender than in most species of the genus; as long or longer than the body; red in color; setae long, acuminate. Maxilla lighter in color than rest of palp; 0.7 mm. long, 0.43 mm. wide. Trochanter about 0.6 mm. long, width 0.42 mm., numerous long setae; two granular sublateral protuberances, the anterior more developed than the proximal one. Femur 1.2 mm. long; 0.465 mm. wide; 2.6 times as long as wide; laterally tumid; smooth except for very fine granulations on the lateral surface; numerous long setae. Tibia 1.12 mm. long, greatest width 0.51 mm.; length 2.2 times the width; lateral margin proximally flattened, convex along the distal half; marked mesial protuberance; smooth; numerous acuminate setae especially on the mesial protuberance. Chela 1.98 mm. long; 0.725 mm. wide; 2.73 times as long as wide; depth of chela 0.75 mm.; hand length about 1.05 mm.; chela smooth with numerous acuminate setae; movable finger about 1 mm. long; venom duct and tooth only in movable finger. Movable finger with a marginal row of over 60 teeth; internal accessory teeth six to eight in number, not contiguous, the row removed some distance from the finger tip; external row of about 16 accessory teeth, evenly spaced along the distal two-thirds of the finger margin. Fixed finger with nearly 60 marginal teeth; about 15 external accessory teeth; seven or eight internal accessory teeth confined to the distal two-fifths of the finger. Movable finger with four sensory setae: *t* about one-third of finger length from tip, *sb* and *b* close to base of finger and less than two areole diameters apart, *st* about equidistant from *b* and *t;* nodus ramosus slightly closer to *t* than to *st.* Fixed finger with two series of tactile setae: external series with *et* less than one-eighth of finger length from tip, *esb* and *eb* near base and less than two areole diameters apart, distance of *esb* to *est* subequal to distance from *est* to *et*, *est* farther from *eb* than from *et;* internal series with *it* slightly more than one-fifth of finger length from tip, distance between *it* and *ist* subequal to distance of *it* from finger tip, *ist* much closer to *it* than to *isb* and *ib*, *isb* and *ib* at base of finger separated by about two areole diameters.

Legs: Anterior legs yellowish brown in color; posterior legs yellow; relatively slender; beset with numerous acuminate setae; claws simple. First leg with trochanter 0.24 mm. long, 0.21 mm. deep; pars basilis of femur 0.31 mm. long, 0.24 mm. deep; pars tibialis 0.64 mm. long, 0.23 mm. deep; entire femur 0.79 mm. long; tibia with weakly S-shaped extensor margin, flexor margin weakly concave, 0.655 mm. long, 0.15 mm. deep, length 4.4 times the depth; tarsus 0.53 mm. long, 0.1 mm. deep. Fourth leg with trochanter 0.44 mm. long, 0.27 mm. deep; pars basilis 0.37 mm. long, 0.29 mm. deep; pars tibialis 0.815 mm. long, 0.315 mm. deep, extensor margin evenly convex, flexor margin nearly straight; entire femur 1.06 mm. long, 0.315 mm. deep, 3.37 times as long as deep, long acuminate setae numerous; tibia 0.92 mm. long, 0.18 mm. deep, 5.1 times as long as deep, extensor margin very slightly concave and with a tactile seta slightly distal to the midpoint, flexor margin weakly convex; tarsus 0.63 mm. long, 1.2 mm. deep, 5.25 times as long as deep, nearly cylindrical in shape; tactile seta 0.165 mm. from the proximal-extensor corner of the tarsus.

Genital complex: Posterior operculum with 12 or 14 setae confined chiefly to a single row; anterior operculum with nearly 30 long setae scattered in position.

Type Locality: Species known only from the male holotype taken by G. C. Wood at Boquete, Chiriqui Province, Panama, January, 1940.

The species is easily differentiated from other members of the genus, except *C. perproximus* Beier, 1933, by a much narrowed chela. Separation from *C. perproximus* may be made on the much more slender tibia and tarsus of the fourth leg of *C. angustochelatus*.

Cordylochernes nigermanus, new species

Figures 9, 10

Male: Body robust; large; 4.6 mm. in length; brown in color. Cephalothorax width nearly equal to length of 1.7 mm.; posterior margin straight, anterior margin rounded; marked median transverse furrow located three-fifths of the distance from the anterior end of the cephalothorax; posterior furrow weaker than the median and close to the posterior margin of the cephalothorax; surface conspicuously granular anterior to the median furrow, smooth behind; setae sparse on the granular portion of the cephalothorax; numerous setae posterior to the median furrow with 14 or 16 setae along the posterior margin; eye spots not distinguishable (KOH treated material). Abdomen ovate, light brown, measuring 2.85 mm. long and 2.25 mm. wide in the treated specimen. Tergites divided except the first and eleventh; each half tergite in the central part of the abdomen with a seta along the mesial border anterior to the marginal row, two setae along the lateral border, and six to eight setae well spaced along the posterior margin. Sternites from four to 10 inclusive divided; the chaetotaxy similar to that of the tergites except for additional marginal setae; each half sternite from five to 10 inclusive with a medially placed seta anterior to the marginal row, one or two setae on the lateral margin, and from eight to 11 setae in the marginal row; total number of setae on each sternite from the fifth to the tenth ranging from 20 to 28; setae of the fourth sternite medial in position, six on each half sternite. Pleural membranes marked by well-developed longitudinal plications. Each anterior stigmatic plate with five setae; posterior plate with three setae.

Chelicera: Width of base 0.31 mm.; flagellum of three setae, the distal one serrate along the anterior margin; laminal seta especially much longer than others; all setae acuminate. Fixed finger with a terminal tooth bearing three denticles on the concave or inner surface; margin of finger with six to eight evenly spaced teeth; serrula interior with six or seven serrate distal teeth, remainder of teeth fused into a velum; lamina exterior present. Movable finger little bent and with length of about 0.46 mm.; apical tooth well developed, little larger than subapical lobe; two minute teeth distal to the subapical lobe and near the level of the insertion of the galeal seta; galea heavily branched, proximally bifurcated (tips broken in specimen); serrula exterior composed of 33 ligulate plates.

Palp: Length about one and one-half times the length of the body; chela and tibia lengths together slightly greater than body length; heavy; dark reddish brown in color; setae abundant, acuminate, many bearing subdistally one to three minute denticles; palpal podomeres appearing smooth except for the finely granular condition of the mesial and dorsal surfaces of the femur. Maxilla 0.99 mm. in length; 0.63 mm. in width. Trochanter with two protuberances, differing somewhat in the trochanters of the right and left sides. Femur pedunculate; laterally tumid; mesial margin slightly convex near center followed proximally by a slight concavity; dorsal surface conspicuously swollen; length 1.7 mm., width 0.75 mm.; length 2.25 times the width. Tibia approximate in length to femur and with well-marked mesial protuberance; width from dorsad 0.85 mm.; width in sublateral view as measured across the protuberance somewhat greater; length 2.1 times the width. Chela heavy; length 2.975 mm.; width 1.25 mm.; depth 1.41 mm.; length of hand 1.65 mm.; length of movable finger 1.5 mm.; movable finger only with poison apparatus and tooth. Fixed finger with eight tactile setae: external series, *eb* and *esb* near base of finger, *et* close to tip, *est* scarcely closer to *et* than to *esb;* internal series, *ib* and *isb* near base of finger, *it* removed from tip of finger by less than one-fourth of finger length, *ist* about two-thirds as far from *it* as from *isb*. Tactile setae of movable finger: *b* and *sb* separated by two or three areole diameters and located near the base of the finger, *t* about one-fourth of finger length from tip of finger, *st* about twice as far from *t* as from *sb;* nodus ramosus closer to *t* than to *st*. Marginal teeth of movable claw poorly developed, numerous, contiguous, extending in a row from near the poison claw to a point not far from the base of the finger, distal teeth of the row more acute and well developed than the proximal teeth; external row of 18 to 20 accessory teeth evenly spaced along the distal three-fourths of the finger; internal row of about 16 conical teeth confined to the distal one-half of the finger. Teeth of the margin of the fixed finger similar in position and shape to the corresponding row on the movable finger; internal accessory teeth about 14 in number and confined to the distal half of the finger; external row with 18 to 20 smaller, but well-spaced teeth dispersed throughout the distal two-thirds of the finger.

Legs: Moderately slender; terminal claws simple; anterior legs darker in color than the posterior. First leg with pars basilis 0.48 mm. long, 0.35 mm. deep; pars tibialis 1.01 mm. long, 0.33 mm. deep; entire femur 1.25 mm. long; tibia 1.03 mm. long, 0.215 mm. deep, flexor margin slightly convex, distal portion of extensor margin nearly straight; tarsus cylindrical in shape, length 0.74 mm., depth 0.14 mm. Fourth leg with trochanter length 0.705 mm., depth 0.36 mm., almost twice as long as deep; pars basilis triangular, 0.54 mm. in length, 0.385 mm. in depth; pars tibialis 1.28 mm. long, 0.43 mm. deep; length of entire femur 1.61 mm., 3.7 times as long as deep; tibia 1.44 mm. in length, depth 0.245 mm., ratio of length to depth 5.9, a long sensory seta slightly distal to the midpoint of the extensor margin; tarsus cylindrical, elongated, length 0.88 mm., depth 0.16 mm., length 5.5 times the depth, flexor margin slightly convex, extensor margin slightly concave, sensory seta about 0.23 mm. from the proximal-extensor corner of the podomere.

Genital complex: Posterior operculum with nearly 25 setae; anterior operculum with more than 30 long setae.

TYPE LOCALITY: A single specimen, male holotype, was found with several individuals of *C. panamensis*, new species, in a collection labeled "'Parasites' found on large beetle caught at Gatun Lock." Collector and date unknown.

C. nigermanus is peculiar in the large number of plates composing the serrula exterior of the chelicera and the more than ordinary number of accessory teeth on the movable finger of the chela.

Cordylochernes panamensis, new species

Figures 11–15

MALE: Body robust, heavy; length 3.2–3.6 mm.; brown color. Cephalothorax rounded anteriorly; posterior margin straight, with a marginal row of about 20 setae; length of cephalothorax 1.29–1.3 mm., width slightly less; two transverse furrows, the median located five-eighths of the length of the cephalothorax from the anterior end and slightly more marked than the posterior transverse furrow; sides and dorsal surface of cephalothorax anterior to median furrow reddish brown; laterally granular, medially almost smooth; area posterior to median furrow smooth, yellowish brown; eye spots not observed (treated specimens). Abdomen subovate; light brown; length 1.9–2.3 mm.; width slightly greater than two-thirds of length. Tergites divided except for the incompletely divided or entire first and the undivided eleventh; each half tergite with a medial seta placed anterior to the marginal row, one or two lateral setae, and six to eight marginal setae; total setae for each tergite ranging from 18 to 22. Sternites from the fourth to tenth inclusive divided; chaetotaxy similar to that of the tergites except for an average of about 10 marginal setae in each half sternite; setae of the marginal row usually much shorter than the medial and lateral setae; all setae acuminate; fourth sternite with five or six relatively long setae in the mesial half of each scutum. Pleural membranes yellow, marked by numerous, conspicuous longitudinal plications. Apparently four or five setae on each stigmatic plate.

Chelicera: Width of base 0.24–0.27 mm.; basal and subbasal setae shorter than the interior and laminal setae; flagellum of three setae, the distal with 10 to 12 serrations along the anterior edge. Movable finger 0.35–0.4 mm. long; internal margin of finger entire except for the subapical lobe and two weak denticles at the level of the insertion of the galeal setae; serrula exterior consisting of 28 ligulate plates; galea subequally bifurcated near the base, each primary ramus branched. Fixed finger with terminal tooth displaying either two or three dentations on the concave margin, followed distally by six or seven teeth along the inner margin of the finger; serrula interior with basal teeth fused to form a velum, distal five or six teeth separate and serrate; lamina exterior present.

Palp: Heavy, dark reddish brown; smooth except for very fine granulations on the trochanter, on the mesial surface of the femur and tibia, and on the internal surface of the hand near the base of the finger; setae numerous, slender, often with one or two very fine subdistal dentations. Maxilla slightly lighter in color than other palpal podomeres; 0.76–0.79 mm. long; 0.47–0.49 mm. wide. Trochanter with two unequal sublateral protuberances, width greater than two-thirds of the length. Femur with mesial edge slightly convex; laterally very convex, centrally swollen; length 1.2–1.25 mm., width 0.52–0.54 mm., length 2.3 times the width. Tibia with proximal half of lateral margin little convex, distal half markedly convex; well-developed, but variable, medio-dorsal protuberance present; setae of protuberance not much more conspicuous than other setae of podomere; length 1.17–1.28 mm., width from dorsad 0.54–0.61 mm., length 2.1 to 2.25 times the width. Chela moderately stout; setae acuminate, fairly numerous, often with one or two weak dentations near the tip; length 2 2.2 mm., width 0.8 0.9 mm., length 2.45 to 2.65 times the width; hand length 1.1–1.2 mm., somewhat greater than the length of the movable finger; depth of hand subequal to the finger length, exceeding the width of the hand by 10 per cent to 20 per cent; movable finger with length of 0.97–1.01 mm., usually conspicuously bent just distal to the midpoint, rarely more evenly curved; with poison apparatus and tooth; nodus ramosus near the level of the proximal tooth of the internal row, closer to base of tactile seta *t* than *st*. Movable finger with four tactile setae: *t* between one-third and one-fourth of finger length from tip of finger; *sb* and *b* proximal in position, separated by less than two areole diameters; *st* about two-thirds as far from *sb* as from *t*. Fixed finger without poison apparatus; with eight tactile setae. External series of four tactile setae: *et* with a weak areole and placed between one-eighth and one-tenth of finger length from finger tip; *est* anterior to the midpoint of the finger and somewhat nearer to *et* than to *esb*; *esb* and *eb* near base, close to inner margin of finger and separated by less than two areole diameters. Internal series of four tactile setae: *ib* and *isb* near base of finger about three areole diameters apart; *it* removed from finger tip by close to one-fourth of finger length; *ist* between two-thirds and three-fourths as far from *it* as latter is from tip of finger; *ist* about twice as far from *ib* as from *it*. Movable finger with marginal and accessory teeth; marginal teeth more than 50 in number, contiguous, confined to the distal three-fourths of the finger; internal accessory teeth seven to eight in number, conical, bases of teeth contiguous, distalmost tooth removed from the finger tip by about one-eighth of the finger length; external row of about 15 teeth, well separated and dispersed along the distal two-thirds of the finger length. Fixed finger with marginal teeth similar to those of the opposing finger; external row of about 15 accessory teeth, hardly more elevated than the teeth of the marginal row, well spaced along the distal three-fifths of the finger; mesial or internal row of about 10 teeth, well separated, confined to less than the terminal one-half of the finger.

Legs: Moderately slender, yellow to light reddish brown, the anterior legs lighter in color than the posterior; terminal claws without accessory teeth. First leg with trochanter about five-sixths as deep as long; pars basilis of femur subrectangular in shape, length 0.32 0.36 mm., depth 0.26-0.27 mm.; pars tibialis 0.7 0.76 mm. in length, 0.25 0.26 mm. in depth; entire femur 0.88 0.91 mm. long; tibia 0.71 0.77 mm. long, 0.17 0.18 mm. deep, 4.2 to 4.4 times as long as deep; tarsus cylindrical, with nearly straight and parallel margins, length 0.57–0.58 mm., depth 0.115–0.12 mm., 4.8 to 5 times as long as deep. Fourth leg with trochanter nearly 0.5 mm. long, depth about one-half of length; pars basilis triangular, 0.39–0.42 mm. long, 0.29–0.305 mm. deep; pars tibialis with extensor margin slightly and evenly convex, flexor margin little convex especially near the proximal end, length 0.9–0.95 mm., depth 0.34-0.36 mm.; entire femur 1.12–1.22 mm. long, 0.345–0.36 mm. deep, length 3.25 to 3.5 times the depth; tibia gradually widened distally, 1.01–1.07 mm. in length, 0.2–0.205 mm. in depth, length 5.05 to 5.35 times the depth; tarsus with almost straight and parallel margins, 0.675–0.72 mm. in length, 0.13–0.135 mm. in depth, length 5 to 5.4 times the depth. Pars basilis of femur with prominent sensory seta on flexor side; tactile seta of tibia somewhat distal to the midpoint of the extensor surface; sensory seta of tarsus proximal, between 0.15-0.175 mm. from the proximal-extensor corner of the podomere.

Genital complex: Three transverse rows of setae on the posterior operculum: anterior row usually of two setae, second row of about four setae, third or posterior row frequently with 12 setae. Usually 14 to 16 setae on the anterior operculum.

FEMALE: The body in general outline, shape and size of cephalothorax and abdomen, and chaetotaxy of the tergites and sternites similar in male and female.

Chelicera: Width of base 0.23-0.24 mm.; galea basally bifurcated; both rami branched; movable finger length 0.35 0.37 mm.; serrula exterior with 26 to 28 plates; otherwise as in the male.

Palps: Color and sculpture similar in the two sexes; podomeres smaller in relation to the body than in the male. Maxilla length 0.73-0.79 mm., width 0.43–0.51 mm. Trochanter almost as in the male. Femur length 1.04–1.15 mm., width 0.46–0.54 mm.; 2.1 to 2.3 times as long as wide. Tibia without mesial protuberance, mesial margin evenly convex; length 1.05–1.15 mm., width 0.49-0.58 mm., length 2 to 2.2 times the width. Chela not so stout as in the male, length 1.9-2.1 mm., width 0.7-0.8 mm., length 2.6 to 2.8 times width;

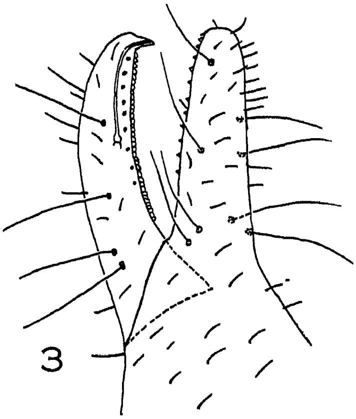
length of hand more than 10 per cent greater than length of movable finger; depth of hand 0.7–0.8 mm.; width and depth of hand subequal; movable finger not markedly angular near the midpoint, stouter than in the male; length of movable finger 0.9–0.975 mm.; movable finger only with venom apparatus and tooth. Tactile setae of movable finger of female similar to that of the male except that the distance from *st* to *sb* is from three-fourths to four-fifths of the distance from *st* to *t*. Tactile setae of the fixed finger similar in position to those of the male. Marginal teeth of movable finger like those of the male except frequently somewhat fewer in number; internal row of accessory teeth consisting of only two to three, occasionally four, well-formed teeth, separated from one another by about the width of the base of the tooth, and placed proximal to the terminal one-sixth of the finger; external row of 10 to 13 teeth evenly spaced throughout most of the distal three-fifths of the finger length. Fixed finger with marginal teeth similar to those of the male except often fewer in number; teeth of external accessory row about 15 in number, conical in shape, uniformly spaced along the distal two-thirds to three-fourths of the finger; three to five (occasionally six) internal accessory teeth, well separated, and confined to the distal one-third to one-fourth of the finger.

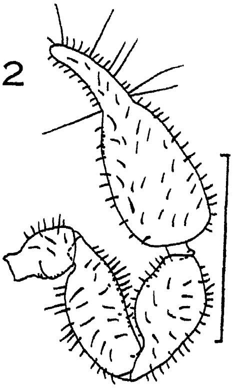
Legs: Very similar to those of the male. First leg with pars basilis 0.31–0.35 mm. long, 0.24–0.28 mm. deep; pars tibialis 0.65–0.72 mm. long, 0.23–0.26 mm. deep; tibia with flexor margin convex, distal portion of extensor surface concave, length 0.66–0.74 mm., depth 0.15–0.17 mm.; tarsus cylindrical, 0.52–0.56 mm. long, 0.11–0.12 mm. deep, length 4.7 to 5 times as great as the depth. Fourth leg with pars basilis 0.385-0.43 mm. long, 0.275–0.34 mm. deep; pars tibialis 0.83–0.95 mm. long, 0.32–0.38 mm. deep; entire femur 1.06–1.28 mm. long, 0.32-0.38 mm. deep, length 3.1 to 3.45 times the depth; tibia 0.95–1.1 mm. long, 0.19–0.21 mm. deep, length 4.95 to 5.2 times the depth; tarsus 0.64–0.7 mm. in length, 0.13 mm. in depth, length 4.9 to 5.2 times the depth. Sensory seta of pars basilis and tibia as in the male; sensory seta of tarsus 0.15–0.18 mm. from proximal-extensor corner of podomere.

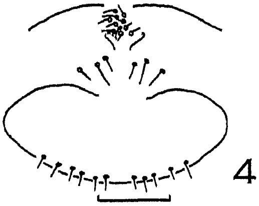
Genital complex: Posterior operculum with 16 to 18 short setae arranged to form a marginal row. Anterior operculum with a group of four or five short setae sublateral to the genital opening on each side and an anterior, median, compact group of about 18 setae.

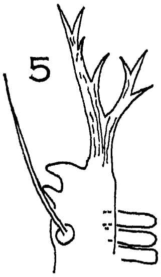
TYPE LOCALITY: Type specimens from two collections taken in the Canal Zone. The male holotype, female allotype, two male paratypes, and four female paratypes from a collection bearing the label: " 'Parasites' found on large beetle caught at Gatun Lock"; one male paratype from a collection marked "Barro Colorado, C. Z., Curran, xii-25-1928." The only other pseudoscorpion in either of these collections is a single individual of the species *C. nigermanus*, new species, taken from the beetle at Gatun Lock.

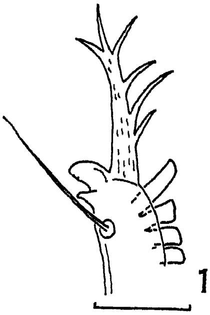
C. panamensis appears closely related to *C. costaricensis* Beier, a species whose geographical range may be expected to overlap the range of *C. panamensis*. Separation of the two forms may be made on the stouter tarsus of the fourth leg and the shape of the palp in *C. panamensis*.

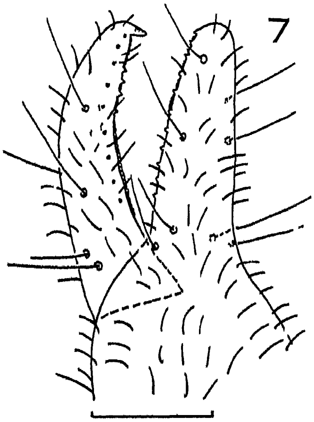












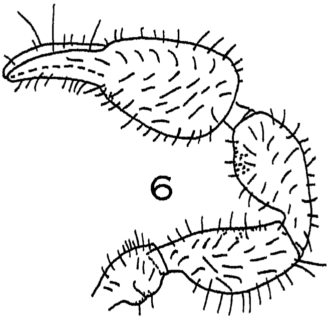


Fig. 1. *Lamprochernes ellipticus*, new species, female holotype, distal end of movable finger of chelicera (scale equals 0.05 mm.).
Fig. 2. Idem, dorsal view of palp (scale equals 1 mm.).
Fig. 3. Idem, external view of fingers and part of hand (scale equals 0.25 mm., as in fig. 7).
Fig. 4. Idem, setae of genital complex (scale equals 0.1 mm.).
Fig. 5. *Lustrochernes dominicus*, new species, male holotype, distal portion of movable finger of chelicera (scale equals 0.05 mm., as in fig. 1).
Fig. 6. Idem, dorsal view of palp (scale equals 1 mm., as in fig. 2).
Fig. 7. Idem, fingers and part of hand in external view (scale equals 0.25 mm.).

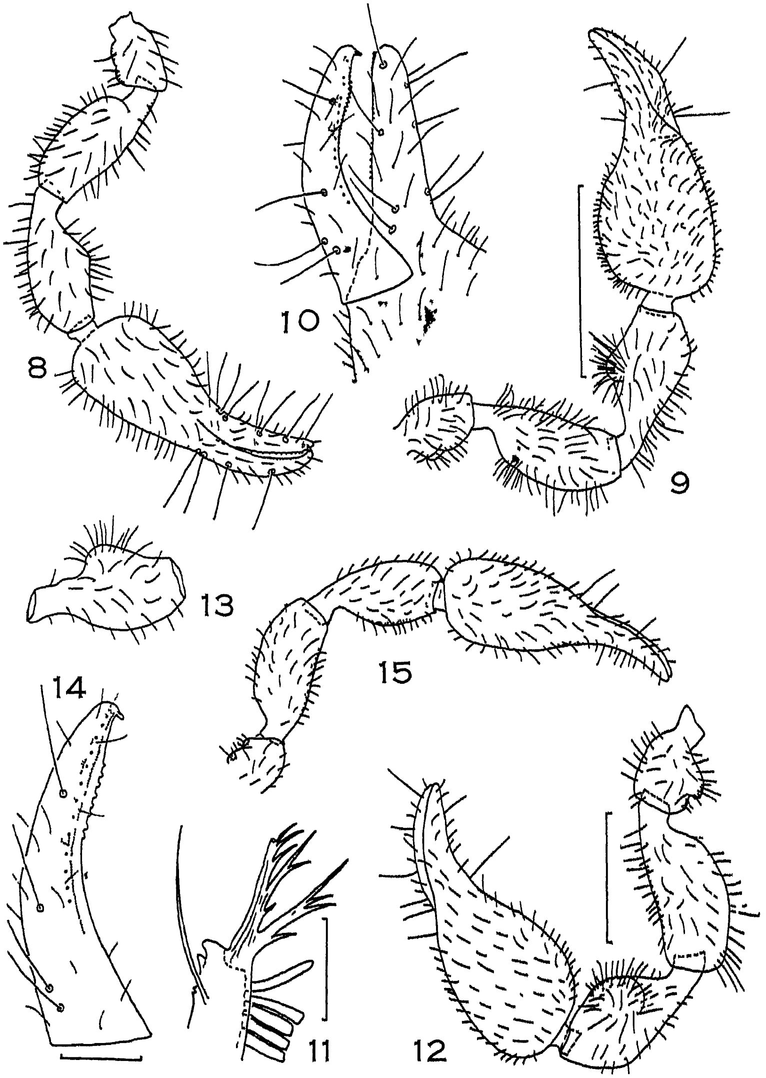


Fig. 8. *Cordylochernes angustochelatus*, new species, male holotype, ventral view of palp (scale equals 1 mm., as in fig. 12).

Fig. 9. *Cordylochernes nigermanus*, new species, male holotype, dorsal view of palp (scale equals 2 mm.).

Fig. 10. Idem, external view of fingers (scale equals 1 mm., as in fig. 2).

Fig. 11. *Cordylochernes panamensis*, new species, male holotype, distal portion of movable finger (tip of galea broken) of chelicera (scale equals 0.1 mm.).

Fig. 12. Idem, dorsal view of palp (scale equals 1 mm.).

Fig. 13. Idem, male paratype from Gatun Lock, sublateral view of tibia to show protuberance in profile (scale equals 1 mm., as in fig. 12).

Fig. 14. Idem, male paratype from Barro Colorado, external view of movable finger (scale equals 0.25 mm.).

Fig. 15. Idem, female allotype, dorsal view of palp (scale equals 1 mm., as in fig. 12).